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NATIONAL DAM SAFETY PROGRAM. LEE MCLEAN & JOHN G. HAMMONS LAKE --ETC(U)
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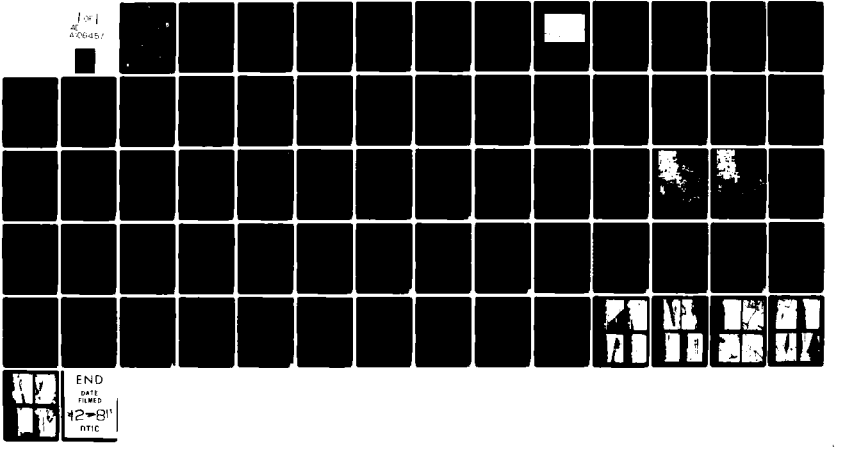

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LEE McLEAN & JOHN Q. HAMMONS LAKE #3

GREENE COUNTY, MISSOURI

MO 20397

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY INSPECTION

United States Army
Corps of Engineers
...Serving the Army
...Serving the Nation

St. Louis District

PREPARED BY: U.S. ARMY ENGINEER DISTRICT, ST. LOUIS

FOR: STATE OF MISSOURI

AUGUST 1979

UNCLASSIFIED

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19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)* Dam Safety, Lake, Dam Inspection, Private Dams		
20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)* This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based on available data and on visual inspection, to determine if the dam poses hazards to human life or property.		

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DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
210 NORTH 12TH STREET
ST. LOUIS, MISSOURI 63101

IN REPLY REFER TO

SUBJECT: Lee McLean & John Q. Hammons Lake # 3 Dam Phase I Inspection Report

This report presents the results of field inspection and evaluation of the Lee McLean & John Q. Hammons Lake # 3 dam.

It was prepared under the National Program of Inspection of Non-Federal Dams.

This dam has been classified as unsafe, emergency by the St. Louis District as a result of the application of the following criteria:

1) Spillway will not pass a 10-year frequency flood without overtopping of the dam. The spillway is, therefore, considered to be unusually small and seriously inadequate.
2) Overtopping could result in dam failure.
3) Dam failure significantly increases the hazard to life and property downstream.

SUBMITTED BY: SIGNED
Chief, Engineering Division
5 SEP 1979
Date

APPROVED BY: SIGNED
Colonel, CE, District Engineer
5 SEP 1979
Date

LEE McLEAN AND JOHN Q. HAMMONS LAKE #3

GREENE COUNTY, MISSOURI

MISSOURI INVENTORY NO. 20397

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Prepared by

Anderson Engineering, Inc. Springfield, Missouri
Hanson Engineers, Inc., Springfield, Illinois

Under Direction of

St. Louis District, Corps of Engineers

For

Governor of Missouri

August, 1979

PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam:	Lee McLean & John Q. Hammons Lake #3
State Located:	Missouri
County Located:	Greene County
Stream:	Tributary to James River
Date of Inspection:	15 May 1979

Lee McLean and John Q. Hammons Lake #3 was inspected by an interdisciplinary team of engineers from Anderson Engineering, Inc. of Springfield, Missouri and Hanson Engineers, Inc. of Springfield, Illinois. The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

The guidelines used in the assessment were furnished by the Department of the Army, Office of the Chief of Engineers, and they have been developed with the help of several Federal and State agencies, professional engineering organizations, and private engineers. Based on these guidelines, this dam has been classified by the St. Louis District Corps of Engineers as a small size dam with a high downstream hazard potential. The estimated damage zone extends approximately 1 mile downstream of the dam. Located within this zone are two dwellings, one principal road, one small shopping center, and one outbuilding. (Upstream: .2 miles - 5 acre lake; .6 miles - 4 acre lake).

Our inspection and evaluation indicates that the combined spillways do not meet the criteria set forth in the guidelines for a dam having the above size and hazard potential. The spillway will pass about 8 percent of the Probable Maximum Flood without overtopping. The Probable Maximum Flood is defined as the flood discharge that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. The guidelines require that a dam of small size with a high downstream hazard potential pass 50 to 100 percent of the PMF. Considering the existence of two other dams upstream, the volume of water impounded, and the height of the dam, 50 percent of the PMF has been determined to be

the appropriate spillway design flood. The 10-year frequency flood will overtop the dam. The 10-year flood is one that has a 10 percent chance of being exceeded in any given year.

The embankment appeared to be in good condition. Deficiencies visually observed by the inspection team were: (1) erosion of front face of embankment due to wave action and pavement surface runoff; (2) small amount of erosion at north abutment, on downstream face; (3) erosion of soil under end of spillway chute, (4) wet areas at downstream toe between dam embankment and railroad embankment. These areas could be due to spillway runoff, but they should be investigated further.

Another deficiency was the lack of seepage and stability analysis records.

It is recommended that the owners take the necessary action in the near future to correct the deficiencies reported herein. A detailed discussion of these deficiencies is included in the following report.

John M. Healy

John M. Healy, P.E.
Hanson Engineers, Inc.

Steven L. Brady

Steven L. Brady, P.E.
Anderson Engineering, Inc.

Nelson Morales

Nelson Morales, P.E.
Hanson Engineers, Inc.

Tom Beckley

Tom Beckley, P.E.
Anderson Engineering, Inc.

OVERVIEW OF DAM AND LAKE

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

LEE McLEAN AND JOHN Q. HAMMONS LAKE #3 - ID No. 20397

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APPENDICES

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL:

A. Authority:

The National Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of safety inspection of dams throughout the United States. Pursuant to the above, the St. Louis District, Corps of Engineers, District Engineer directed that a safety inspection be made of the Lee McLean and John Q. Hammons Lake #3 in Greene County, MO.

B. Purpose of Inspection:

The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and a visual inspection in order to determine if the dam poses hazards to human life or property.

C. Evaluation Criteria:

Criteria used to evaluate the dam were furnished by the Department of the Army, Office of the Chief Engineers, "Recommended Guidelines for Safety Inspection of Dams, Appendix D." These guidelines were developed with the help of several federal agencies and many state agencies, professional engineering organizations, and private engineers.

1.2 DESCRIPTION OF PROJECT:

A. Description of Dam and Appurtenances:

Lee McLean and John Q. Hammons Lake #3 Dam is an earth fill structure approximately 15 ft. high and 700 ft. long at the crest. The appurtenant works consist of an overflow spillway near the center of the embankment (Sta. 3 + 35). The spillway consists of a triple box culvert with each box being 25 inches high and 4 feet 6 inches wide. Sheet 3 of Appendix A shows a plan profile and typical section of the embankment.

B. Location:

The dam is located in the southeastern part of Greene

County, Missouri on a tributary of the James River. The dam and lake are within the Galloway, Missouri 7.5 minute quadrangle sheet (Section 4, T28N, R21W - latitude 37°9.9'; longitude 93° 14.5'). Sheet 2 of Appendix A shows the general vicinity.

C. Size Classification:

With an embankment height of 15 ft. and a maximum storage capacity of approximately 69 acre-ft., the dam is in the small size category since the storage is greater than 50 acre-feet.

D. Hazard Classification:

The St. Louis District, Corps of Engineers has classified this dam as a high hazard dam which means that loss of life and appreciable property loss could occur in the event of failure of the dam. The estimated damage zone extends approximately 1 mile downstream of the dam. Located within this zone are two dwellings, one principal road, one small shopping center, and one outbuilding. (Upstream: .2 miles-5 acre lake; .6 miles - 4 acre lake).

E. Ownership:

The dam is owned by Lee McLean and John Q. Hammons. The owners' addresses are: Lee McLean - 2610 N. Glenstone, Springfield, Missouri, 65803. (Telephone 417-869-6363); John Q. Hammons - 1525 S. Glenstone, Springfield, Missouri, 65804. (Telephone 417-881-7701).

F. Purpose of the Dam:

The dam was constructed primarily for flood control and esthetics for the surrounding subdivision which is known as Southern Hills.

G. Design and Construction History:

No design information or plans are available. The dam was constructed by Mr. Lee McLean and completed in the early 1960's. Mr. McLean said that the lake area was cleared of topsoil and a core trench was cut down 4 to 5 feet or to bedrock. The core trench was filled with compacted good clay. Mr. McLean also said that the central two-thirds and the inside face of the embankment were built with good clay. The outside face of the embankment was built with less quality clay. All of the embankment soil comes from the lake

area. The owner indicated that no significant problems regarding seepage or stability have occurred since the dam was built. To our knowledge, no modifications have been made since the original construction.

H. Normal Operating Procedures:

All flows are passed by a concrete triple box culvert located near the center of the embankment. The most recent maximum water level occurred in May, 1979, when the water was within a few inches of overtopping the dam.

1.3 PERTINENT DATA:

Pertinent data about the dam, appurtenant works, and reservoir are presented in the following paragraphs. Sheet 3 of Appendix A presents a plan, profile and typical section of the embankment.

A. Drainage Area:

The drainage area for this dam, as obtained from the U.S.G.S. quad sheet, is approximately 635 acres (includes the drainage area of two other upstream dams).

B. Discharge at Dam Site:

(1) All discharge at the dam site is through an uncontrolled spillways.

(2) Estimated Total Spillway Capacity at Maximum Pool (Top of Dam - El. 100.6): 162 cfs

(3) Estimated Capacity of Primary Spillway: 162 cfs

(4) Estimated Experienced Maximum Flood at Dam Site: Unknown

(5) Diversion Tunnel Low Pool Outlet at Pool Elevation: Not Applicable

(6) Diversion Tunnel Outlet at Pool Elevation: Not Applicable

(7) Gated Spillway Capacity at Pool Elevation: Not Applicable

(8) Gated Spillway Capacity at Maximum Pool Elevation: Not Applicable

C. Elevations:

(1) Top of Dam: 100.2 (Low Point); 100.6; (Average).

(2) Principal Spillway Crest: 97.13 (Lowest Point).

(3) Emergency Spillway Crest: None

(4) Principal Outlet Pipe Invert: None

(5) Streambed at Centerline of Dam: 86.6

(6) Pool on Date of Inspection: 97.56

(7) Maximum Tailwater: Unknown

(8) Upstream Portal Invert Diversion Tunnel: Not Applicable

(9) Downstream Portal Invert Diversion Tunnel: Not Applicable

D. Reservoir Lengths:

(1) At Top of Dam: 870 Feet

(2) At Principal Spillway Crest: 850 Feet

(3) At Emergency Spillway Crest: Not Applicable

E. Storage Capacities:

(1) At Principal Spillway Crest: 37 Acre-Feet

(2) At Top of Dam: 69 Acre-Feet

(3) At Emergency Spillway Crest: Not Applicable

F. Reservoir Surface Areas:

(1) At Principal Spillway Crest: 9.2 Acres

(2) At Top of Dam: 12 Acres

(3) At Emergency Spillway Crest: Not Applicable

G. Dam:

(1) Type: Earth Fill

(2) Length at Crest: 700 Feet

(3) Height: 15 Feet

(4) Top Width: 44 Feet

(5) Side Slopes: Upstream 1.3H:IV; Downstream 3.4H:IV

(6) Zoning: Homogeneous. Owner did indicate that a better clay was used in the core, center of dam, and the inside face.

(7) Impervious Core: None, except as noted above.

(8) Cutoff: Owner indicated a cutoff trench was cut down 4 to 5 feet or to bedrock and filled with good compacted clay.

(9) Grout Curtain: None

H. Diversion and Regulating Tunnel:

(1) Type: None

(2) Length: Not Applicable

(3) Closure: Not Applicable

(4) Access: Not Applicable

(5) Regulating Facilities: Not Applicable

I. Spillway:

I.1 Principal Spillway:

(1) Location: Center of embankment (Sta. 3 + 35).

(2) Type: Triple box concrete culvert with each box being 25 inches high and 4 feet 6 inches wide.

I.2 Emergency Spillway:

(1) Location: None

(2) Type: Not Applicable

J. Regulating Outlets: None

SECTION 2 - ENGINEERING DATA

2.1 DESIGN:

No engineering data exists for this dam. No construction inspection records or documented maintenance and operation data exist to our knowledge.

A. Surveys:

No detailed surveys have been made of the dam to our knowledge. Sheet 3 of Appendix A contains information on the benchmark used for the inspection survey.

B. Geology and Subsurface Materials:

The topography around the site is gently rolling to hilly. This area is at the eastern edge of the Western Plains region of the state. Generally the soils around the dam site consist of deep, well drained, cherty silty clay soils. Those soils are residual from cherty Mississippian limestones. Typically these soils have a brown cherty clayey silt surface layer followed by a reddish brown friable silty clay containing considerable chert rock fragments. The lower horizon is a red, dark red crumbly, plastic silty clay which has varing amounts of chert rock. Weathered ledge rock is often found hear the surface in this area. The underlying rock is of the Burlington formation of the Osagean Series of the Mississippian Systems. The Burlington formation is a white to light buff, very coarsely crystalline, fossiliferrous, crinoidal limestone. Layers of chert nodules are common in the upper portions of this formation. This bedrock has often weathered unevenly leaving pinnacles, mushroom-like knobs projecting from the rock surface. The crevices between these knobs are filled with the red, often highly plastic, silty clay.

The bedrock in this area is quite soluble and consequently there are many caves and sinkholes. Several sinkholes are shown on the Galloway 7.5 minute quad around this area. The nearest sink is approximately 400 feet west of the dam.

Geologic mapping of Greene County, Missouri, compiled by Kenneth C. Thomson of Southwest Missouri State University, shows two fault zones near this site. The Kinser Bridge fault runs generally east and west and lies approxi-

mately 1/2 mile to the south of the dam site. The Pierson Creek faults run northwest and southeasterly and the nearest portion of this fault is approximately 1 1/2 miles north of the dam site. The Department of Natural Resources has indicated that the faults in this area are generally considered to be inactive and have been for several hundred million years (rock associated with the Mississippian period is approximately 300 million years old). Additional mapping by Mr. Thomson indicates there are two caves within one quarter mile of the dam site.

C. Foundation and Embankment Design:

No design computations are available. Information from the owner indicates that the dam is composed of materials taken from the lake area upstream of the dam. Our site inspection indicates that these materials are residual silty clays with rock fragments. The owner indicated that a core trench was incorporated under the dam. No internal drainage features were incorporated. The owner also indicated that the center two-thirds and the inside face of the embankment were constructed of good clay while the outside face was of a lesser quality clay. No construction inspection records are available.

D. Hydrology and Hydraulics:

No hydrologic or hydraulic design data were obtained. Our analyses of the PMF are presented in Appendix C. These analyses were based on our field survey and observations, and estimates of areas and volumes from the U.S.G.S. quad sheet. It was concluded that the structure will pass about 8 percent of the Probable Maximum Flood without overtopping. The 10-year frequency flood will overtop the dam.

E. Structure:

The only appurtenant structure is the triple box culvert that serves as the primary spillway. The culvert is concrete and is located near the center of the embankment at Sta. 3 + 35. Each box is 25 inches high by 4 feet 6 inches wide. A 7 inch thick concrete wall separates each box. The concrete appears to be in good condition. The concrete chute down the downstream slope has eroded under the end at the plunge pool. No design information is available.

2.2 CONSTRUCTION:

No construction inspection data have been obtained.

2.3 OPERATION AND MAINTENANCE:

There are no operating records to our knowledge. The embankment appears to be mowed a few times each year.

2.4 EVALUATION:

A. Availability:

No engineering data, seepage or stability analysis, or construction test data were available.

B. Adequacy:

The engineering data available were inadequate to make a detailed assessment of the design, construction, and operation. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record.

C. Validity:

No valid engineering data on the design or construction of the embankment are available to our knowledge.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS:

A. General:

The field inspection was made on 15 May 1979. The inspection team consisted of personnel from Anderson Engineering, Inc. of Springfield, Missouri and Hanson Engineers, Inc. of Springfield, Illinois. The team members were:

Tom Beckley P.E.- Anderson Engineering, Inc. (Civil Engineer)
Steve Brady P.E.- Anderson Engineering, Inc. (Civil Engineer)
Jack Healy P.E.-Hanson Engineers, Inc.(Geotechnical Engineer)
Nelson Morales P.E.- Hanson Engineers, Inc. (Hydrologic and Hydraulic Engineer)

B. Dam:

The dam appears to be generally in good condition. No sloughing or obvious seepage through the embankment was noted. The dam appears to have been constructed with a reverse curvature. The southeastern half is concave downstream and the northwestern half is concave upstream. The dam has a broad crest (44 feet) and has a 22 foot wide asphaltic concrete pavement section with concrete curb and gutter across the entire length of the crest. The dam is fairly level across the crest, however, the center portion of the dam is 1-1 1/2 feet lower than the ends. No surface cracking or unusual movement was obvious. Shallow auger probes into the embankment indicated the top portion of the embankment consists of light red-brown residual silty clay with chert rock fragments.

A few small brush exists on the downstream face, however, in general the embankment was clear. Some small amount of erosion had occurred on the north abutment down to bedrock. This did not appear to be a problem. Pavement runoff on the front face has eroded a channel at Sta. 6+20. There is considerable erosion of the front face of the embankment due to wave action. No riprap was noted on the front face of the embankment. No animal burrows were noted.

A wet area existed on the flood plain between the embankment and a railroad embankment immediately downstream. This wet area could be due to spillway runoff. It is also possible that some leakage could be occurring under the dam

in the area of the old streambed.

No instrumentation (monuments, piezometers, etc.) was observed.

C. Appurtenant Structures:

C.1 Primary Spillway and Outlet:

The approach to the spillway is clear and is directly from the lake. The spillway is a triple box concrete culvert. Each box is 25 inches high and 4 feet 6 inches wide. A concrete outlet chute runs down the downstream side of the embankment from the culvert to the plunge pool. Soil has eroded approximately 2 feet back under the end of the chute. The concrete of the box culvert and chute appear to be in good condition. The spillway is fairly free of debris and vegetation downstream.

C.2 Emergency Spillway:

No emergency spillway exists for this dam.

D. Reservoir:

The slopes adjacent to the lake are moderate and no sloughing or serious erosion was noted. The lake is situated in a residential subdivision of paved streets and single family residences and open grass areas. Two other reservoirs exist upstream from this lake. These lakes ae shown on the Galloway, Missouri, 7.5 minute quad sheet (photo revised in 1970). Sedimentation should be minimal.

E. Downstream Channel:

A railroad embankment runs generally parallel to the embankment at approximately 55 feet downstream from the toe of the dam. The spillway channel passes through a twin concrete box culvert. Each box is 6 feet high and 7 feet 6 inches wide. The elevation of the top of the railway embankment at the culvert location is 97.38.

3.2 EVALUATION:

Trees and brush should be cleared on an annual basis. Erosion areas on the dam-abutment contact and on the front face of the embankment should be corrected. The front face of the embankment should be protected to prevent further

erosion by wave action. The end of the spillway chute should be repaired and an end wall used to prevent future erosion. The wet area at the downstream toe, which is possibly underseepage, should be investigated during a dry part of the year by a professional engineer experienced in the design and construction of dams.

Photographs of the dam, appurtenant structures, and the reservoir are presented in Appendix D.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES:

There are no controlled outlet works for this dam. The spillway is uncontrolled, so that the pool is normally controlled by rainfall, runoff and evaporation.

4.2 MAINTENANCE OF DAM:

It appears that brush and trees on the dam are cut a few times each year.

4.3 MAINTENANCE OF OPERATING FACILITIES:

No operating facilities exist for this dam.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT:

The inspection team is unaware of any existing warning system for this dam.

4.5 EVALUATION:

Vegetation on the dam should be cut annually. Erosional areas at the dam-abutment contacts should be corrected and maintained. Erosional areas as previously discussed should be repaired. Erosion control measures such as riprap should be used to prevent future erosion on the upstream face of the dam. The wet area (possibly underseepage) at the downstream toe should be checked during a dry period.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES:

A. & B. Design and Experience Data:

The hydraulic and hydrologic analyses were based on: (1) a field check of spillway dimensions and embankment elevations; and (2) an estimate of the pool and drainage areas from the U.S.G.S. quad sheet. No previous hydraulic or hydrologic studies were obtained. Our hydrologic and hydraulic analyses using U.S. Army Corps of Engineers guidelines appear in Appendix C.

C. Visual Observations:

The approach to the channel is clear and direct from the lake. The concrete triple box culvert appears to be in good condition. The spillway downstream is fairly clear, however it is constricted by a railroad embankment that has twin box culverts.

D. Overtopping Potential:

Based on the hydrologic and hydraulic analysis presented in Appendix C, the spillways will pass about 8 percent of the Probable Maximum Flood. Overtopping of an earthen embankment could cause serious erosion and could possibly lead to failure of the structure. The Probable Maximum Flood is defined as the flood discharge that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. The recommended guidelines from the Department of the Army, Office of the Chief Engineers, require that this structure (small size with high downstream potential pass 50 percent to 100 percent of the PMF, without overtopping. Considering the existence of two other dams upstream, the small volume of water impounded, and the height of the dam, 50 percent of the PMF has been determined to be the appropriate spillway design flood. The structure will not pass a 10-year frequency flood without overtopping.

The routing of the 50 percent of the PMF through the spillways and dams indicates that the dam under consideration will be overtopped by 1.93 ft. at elevation 102.13. The duration of the overtopping will be 10.92 hours, and the maximum outflow will be 5878 c.f.s. The routing of the 100-

years frequency flood indicates that the dam will be overtopped by 0.95 ft. The duration of the overtopping will be 5.00 hours and the maximum outflow will be 2175 c.f.s.

The routing of the 10 year frequency flood through the spillway and dam indicate that the dam will be overtopped by 0.66 ft. at elevation 100.86. The duration of the overtopping will be 2.67 hours and the maximum outflow will be 1322 cfs. The maximum discharge capacity of the spillway is 162 cfs.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY:

A. Visual Observations:

Visual observations which could adversely affect the structural stability of this dam are discussed in Sections 3.1B and 3.2.

B. Design and Construction Data:

No design and construction data for the foundation and embankment were available. Seepage and stability analyses comparable to the requirements of the guidelines were not available, which constitutes a deficiency which should be rectified.

C. Operating Records:

No operating records have been obtained.

D. Post-Construction Changes:

The inspection team is not aware of any post-construction changes to the dam.

E. Seismic Stability:

The structure is located in seismic zone 1. The magnitude of the earthquake recommended for this zone would not generally be expected to cause severe structural damage to a well constructed earth dam of this size. However, it is recommended that the prescribed seismic loading for this zone be applied in stability analyses for this dam.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT:

This Phase I inspection and evaluation should not be considered as being comprehensive since the scope of work contracted for is far less detailed than would be required for an in-depth evaluation of dams. Latent deficiencies, which might be detected by a totally comprehensive investigation, could exist.

A. Safety:

The embankment is generally in good condition. Several items were noted during the visual inspection which should be corrected or controlled. These items are: (1) some brush and tree growth on the dam; (2) minor erosion at the north dam-abutment contacts; (3) pavement runoff erosion on the front face at Sta. 6 + 20; (4) installation of erosion control measures such as riprap on the front face of the embankment; (5) repair of erosion under end of spillway chute and installation of end wall to prevent future erosion; (6) possible seepage (wet area) at the downstream toe.

The dam will be overtopped by flows in excess of 8 percent of the Probable Maximum Flood. Overtopping of an earthen embankment could cause serious erosion and could possibly lead to failure of the structure. The 22 foot wide asphalt pavement will act as a deterrent to erosion on the dam.

B. Adequacy of Information:

The conclusions in this report were based on review of the information listed in Section 2.1, the performance history as related by others, and visual observation of external conditions. The inspection team considers that these data are sufficient to support the conclusions herein. Seepage and stability analyses comparable to the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency.

C. Urgency:

The remedial measures recommended in paragraph 7.2 should be accomplished in the near future. If the deficiencies listed in paragraph A are not corrected, and if good maintenance is not provided, the embankment condition will

continue to deteriorate and possibly could become serious in the future. High priority should be given to increasing the size of the spillway and/or height of the dam.

D. Necessity for Phase II:

Based on the result of the Phase I inspection, no Phase II inspection is recommended.

E. Seismic Stability:

The structure is located in seismic zone 1. The magnitude of the earthquake recommended for this zone would not generally be expected to cause severe structural damage to a well constructed earth dam of this size. However, it is recommended that the prescribed seismic loading for this zone be applied in any stability analyses performed for this dam.

7.2 REMEDIAL MEASURES:

The following remedial measures and maintenance procedures are recommended. All remedial measures should be performed under the guidance of a professional engineer experienced in the design and construction of dams.

(1) Spillway size and/or height of dam should be increased to pass 50 percent of the PMF. In either case, the spillway should be protected to prevent erosion.

(2) Seepage and stability analyses comparable to the requirements of the recommended guidelines should be performed by an engineer experienced in the construction of dams.

(3) Brush and tree growth on the dam should be removed on a regular basis.

(4) Erosion areas on the embankment should be corrected and maintained.

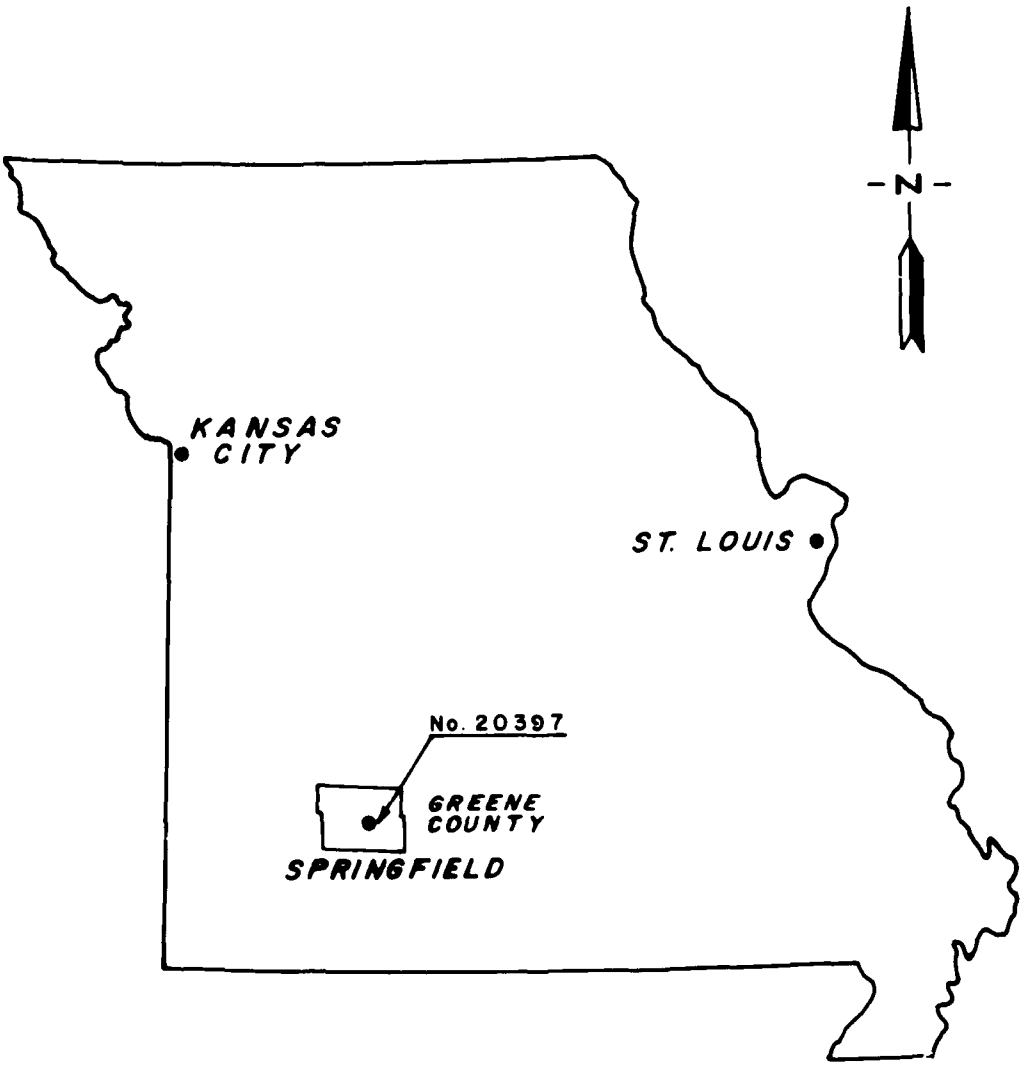
(5) Repair of erosion under the spillway chute at the downstream toe and installation of an end wall to prevent future erosion.

(6) The possible seepage area at the downstream toe should be evaluated by a professional engineer experienced in the design of dams.

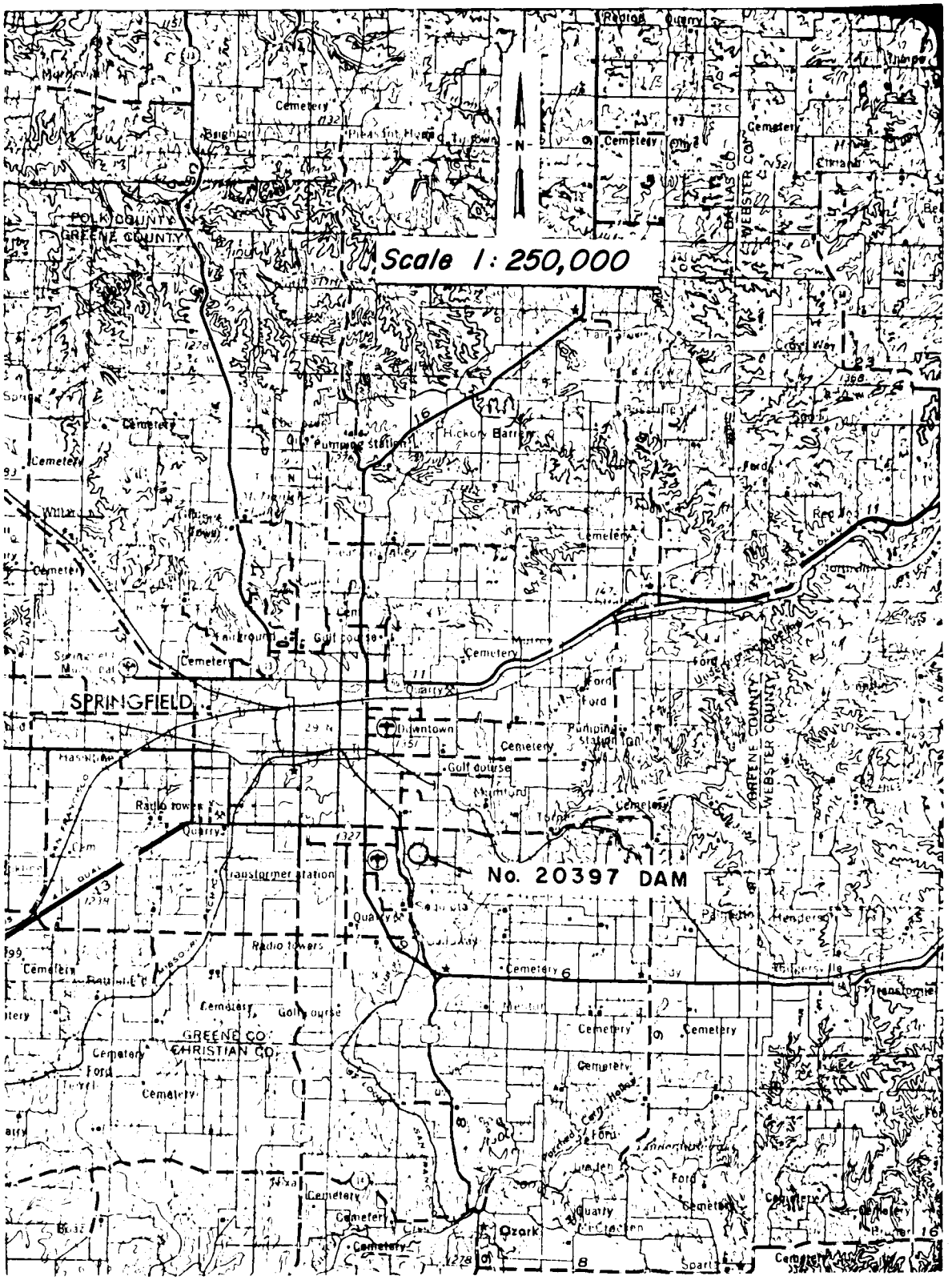
(7) The concrete box culvert should be inspected periodically and repaired if necessary.

(8) A detailed inspection of the dam should be made periodically by a professional engineer experienced in the design and construction of dams.

APPENDIX A

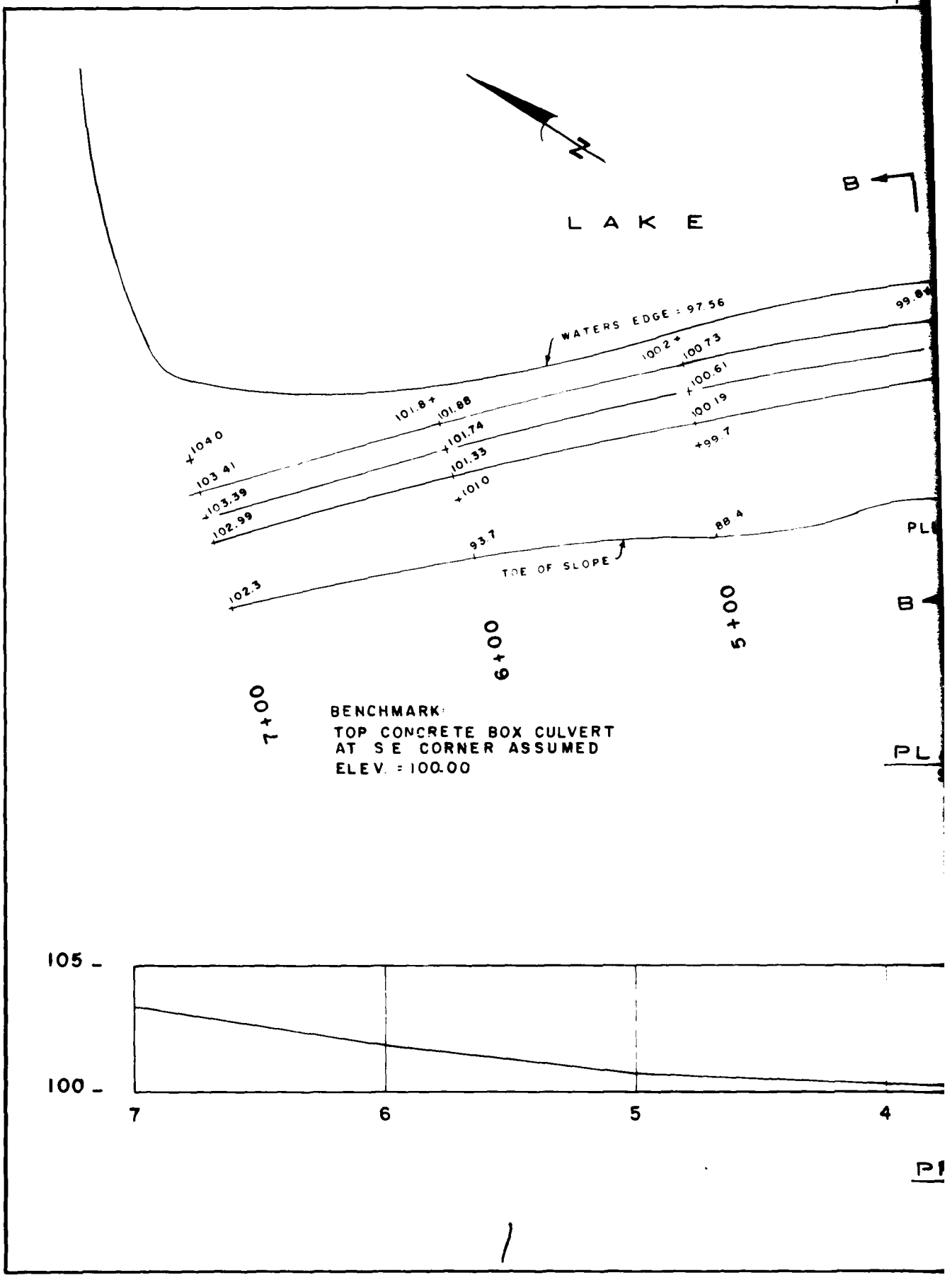


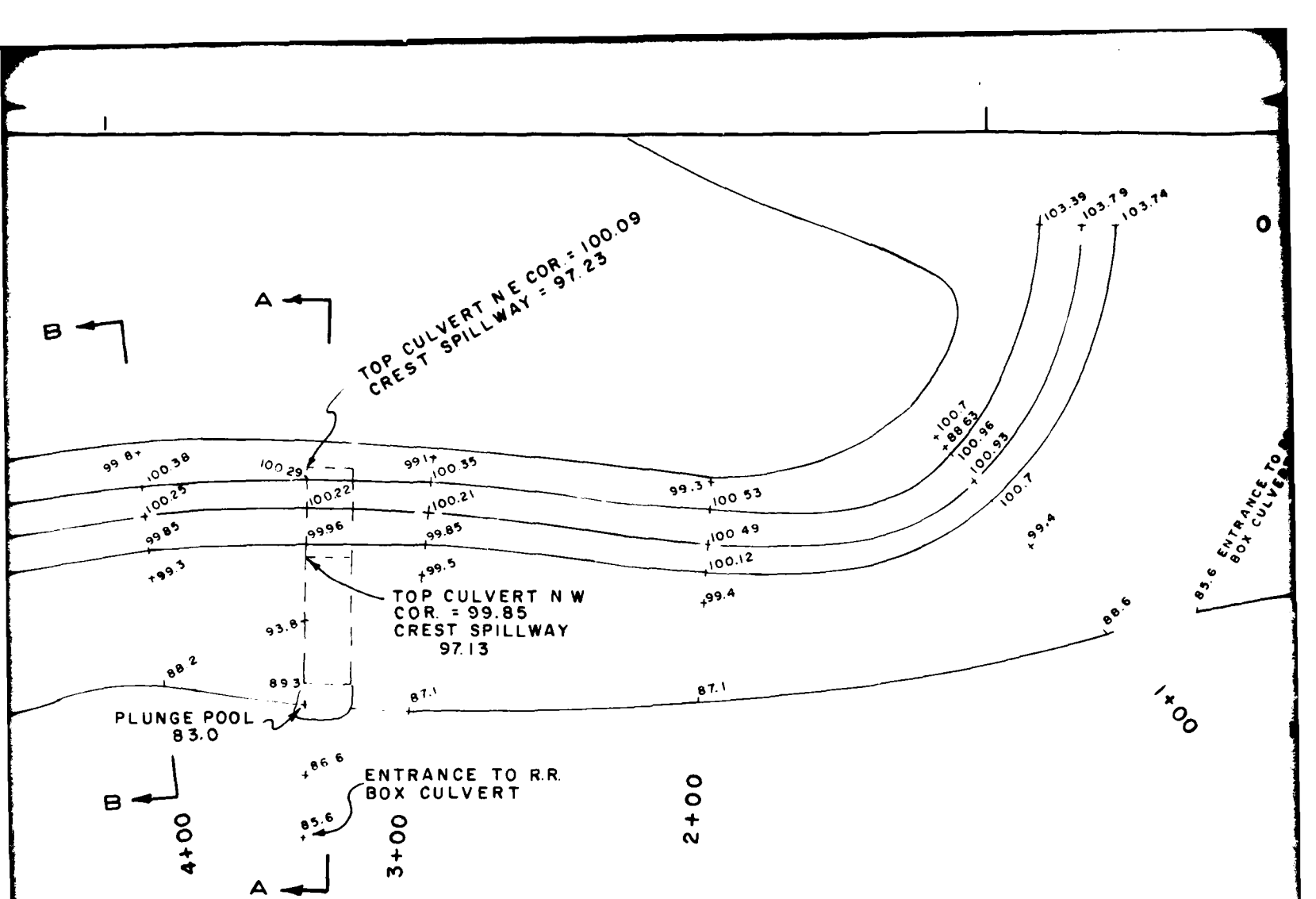
LOCATION MAP



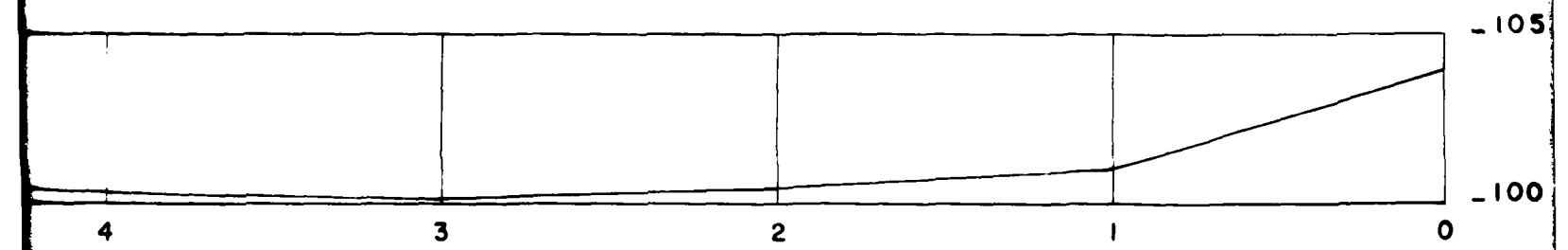
SITE VICINITY MAP

Sheet 2 Appendix A

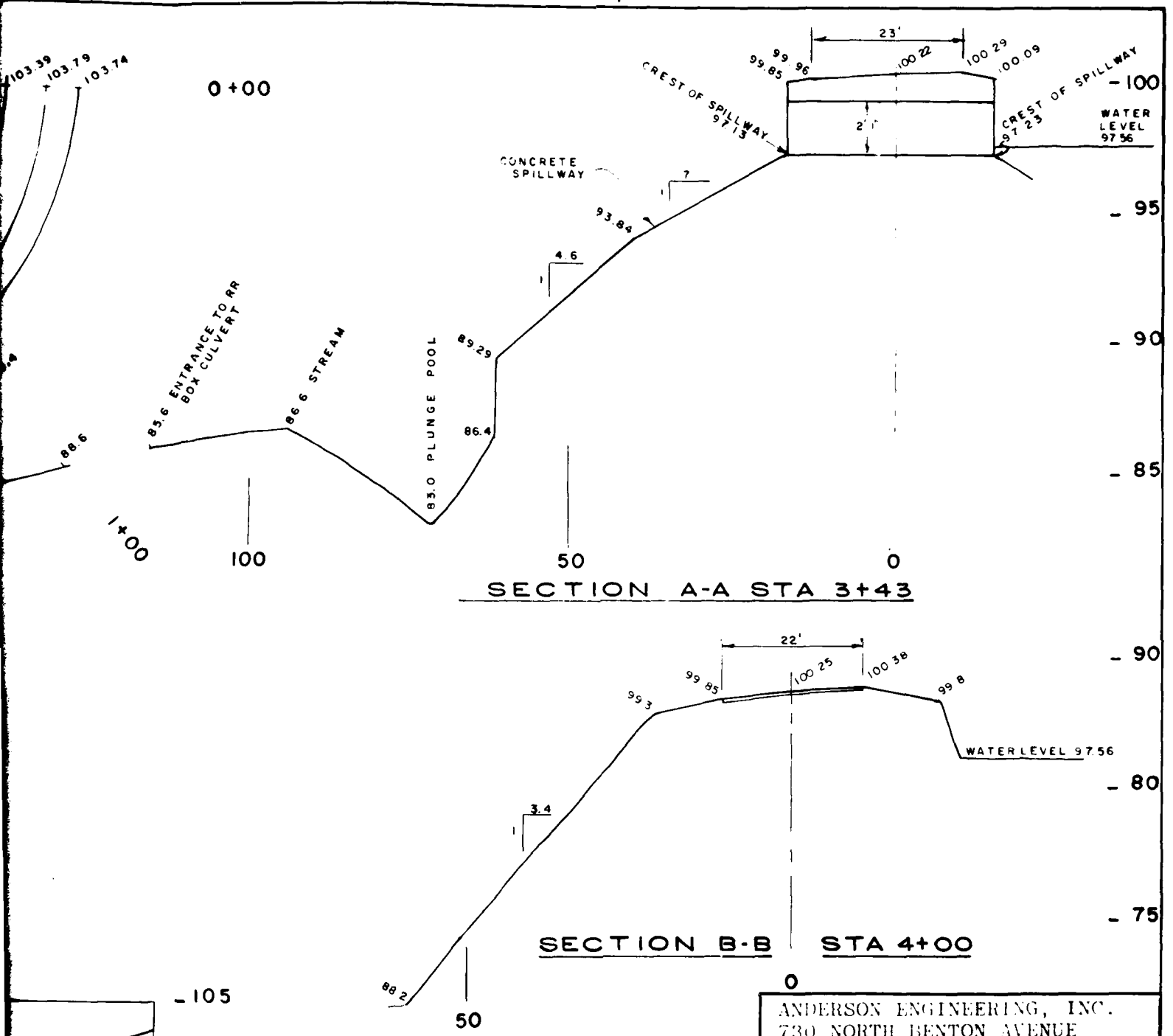

N
B
LAKE
WATERS EDGE = 97.56
99.8+
100.2+
100.73
100.61
100.19
+99.7
101.8+
101.88
101.74
101.33
+101.0
+104.0
103.41
103.39
102.99
102.3
93.7
88.4
TOE OF SLOPE
PL
B
5+00
6+00
7+00
BENCHMARK:
TOP CONCRETE BOX CULVERT
AT S E CORNER ASSUMED
ELEV. = 100.00
PL
105
100
7
6
5
4
PI



PLAN VIEW
SCALE 1"=50'

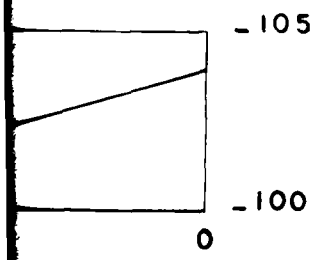


PROFILE



SECTION A-A STA 3+43

SECTION B-B STA 4+00



ANDERSON ENGINEERING, INC.
730 NORTH BENTON AVENUE
SPRINGFIELD, MISSOURI 65802

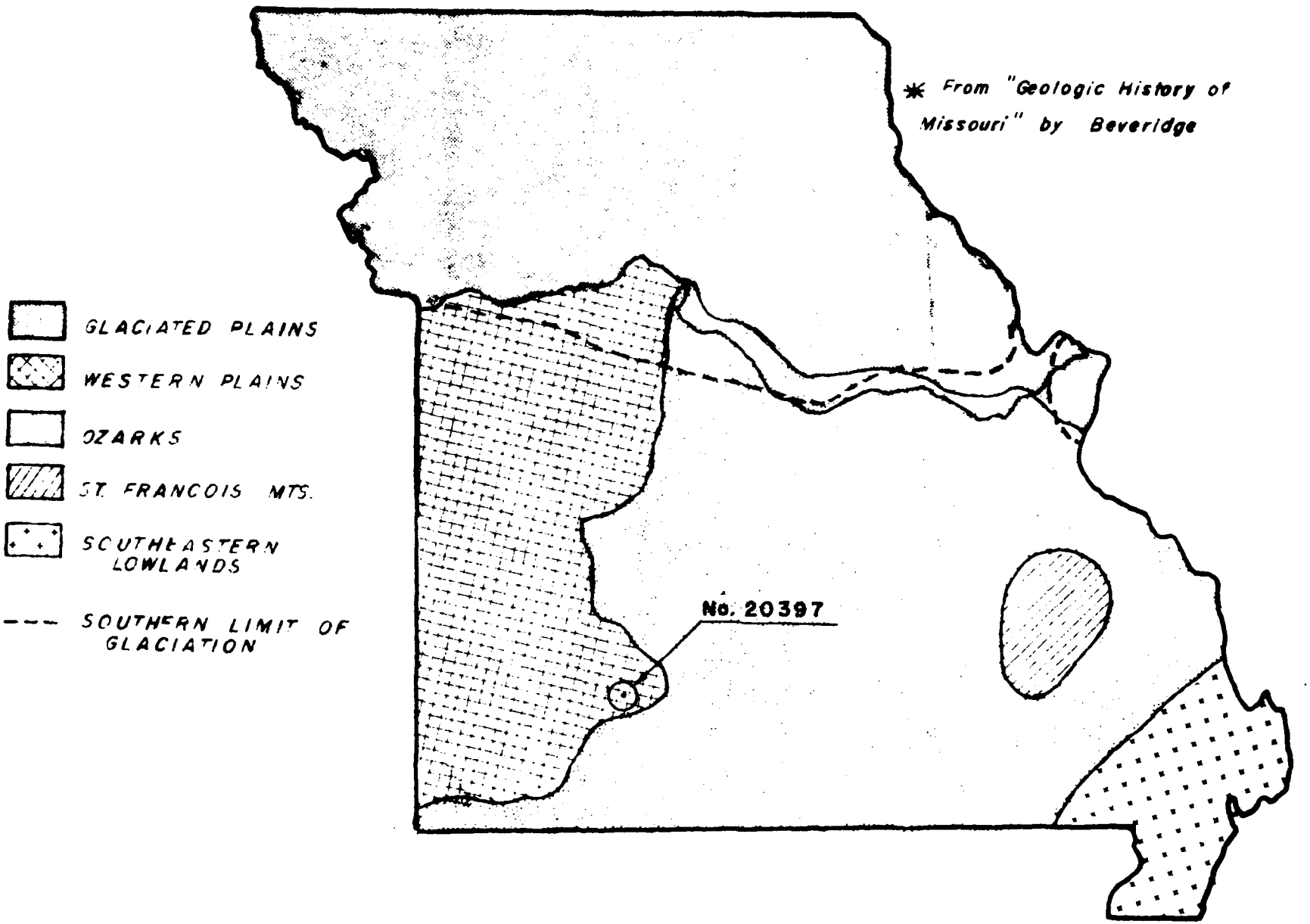
LEE Mc LEAN AND
JOHN Q. HAMMONS LAKE #3
MO. No. 20397

PLAN & PROFILE

GREENE COUNTY, MO.

APPENDIX B

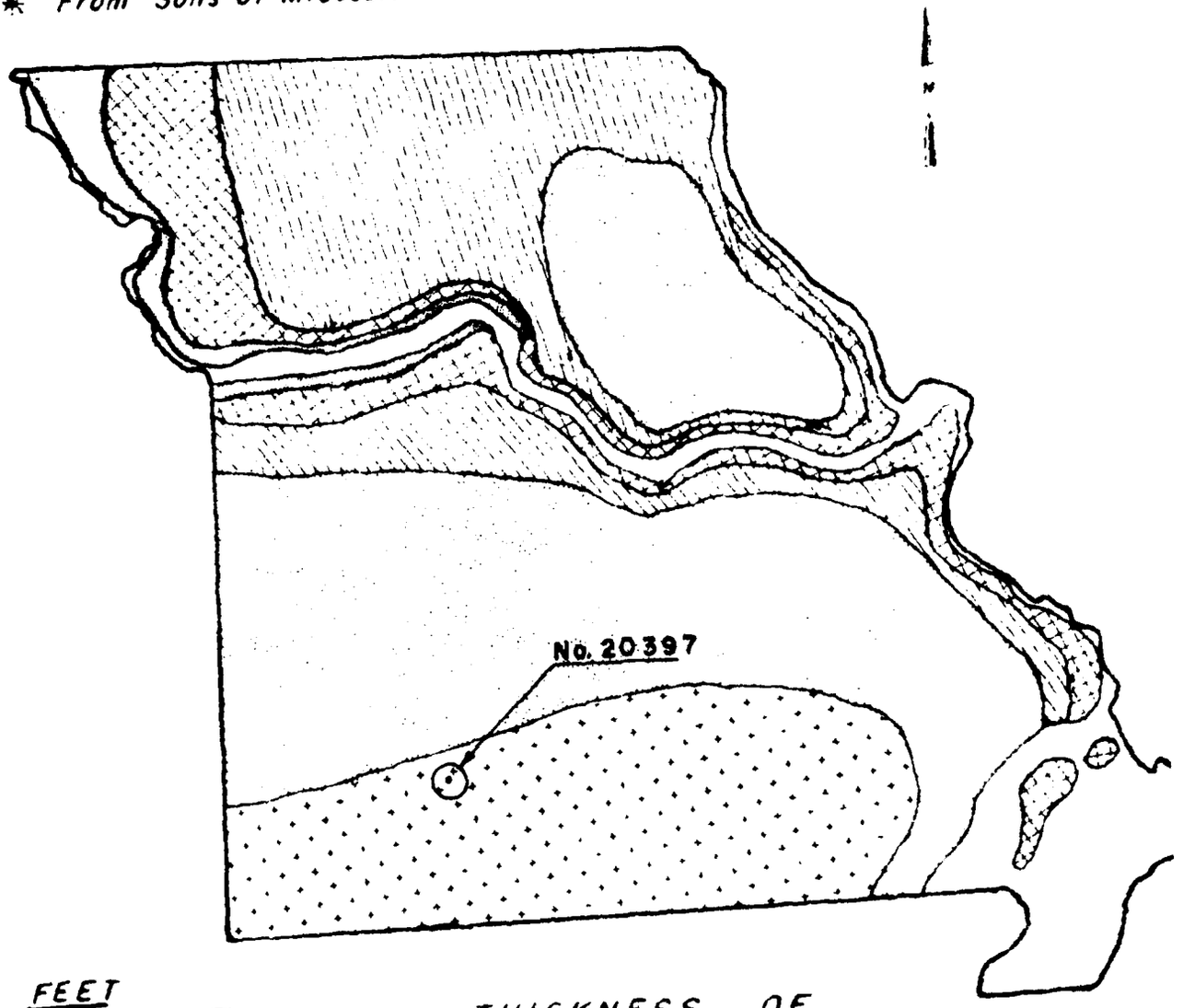
MAJOR GEOLOGIC REGIONS OF MISSOURI



* From "Geologic History of Missouri" by Beveridge

SHEET 1 OF APPENDIX B

* From "Soils of Missouri"



FEET

20+

10 - 20

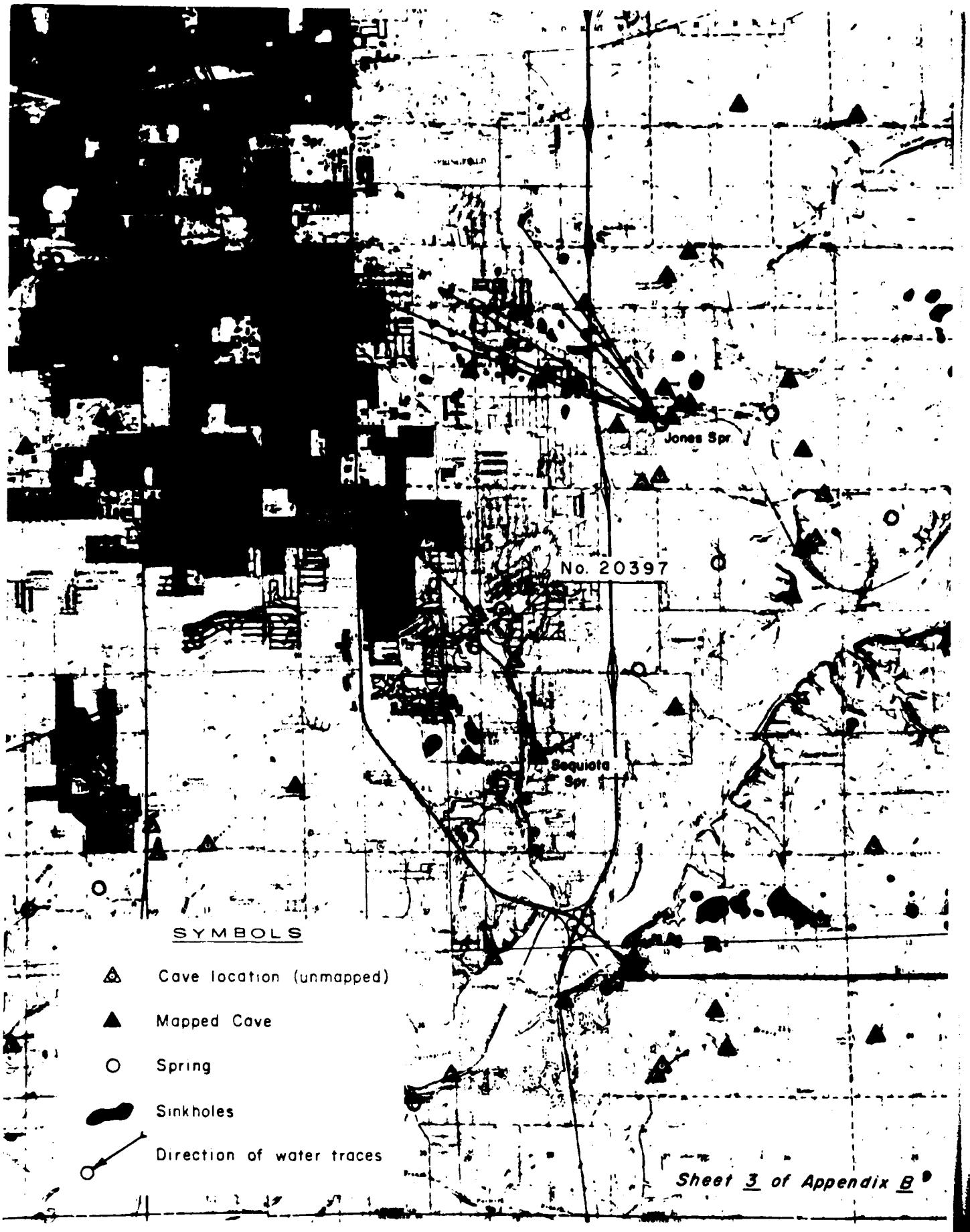
5 - 10

2.5 - 5

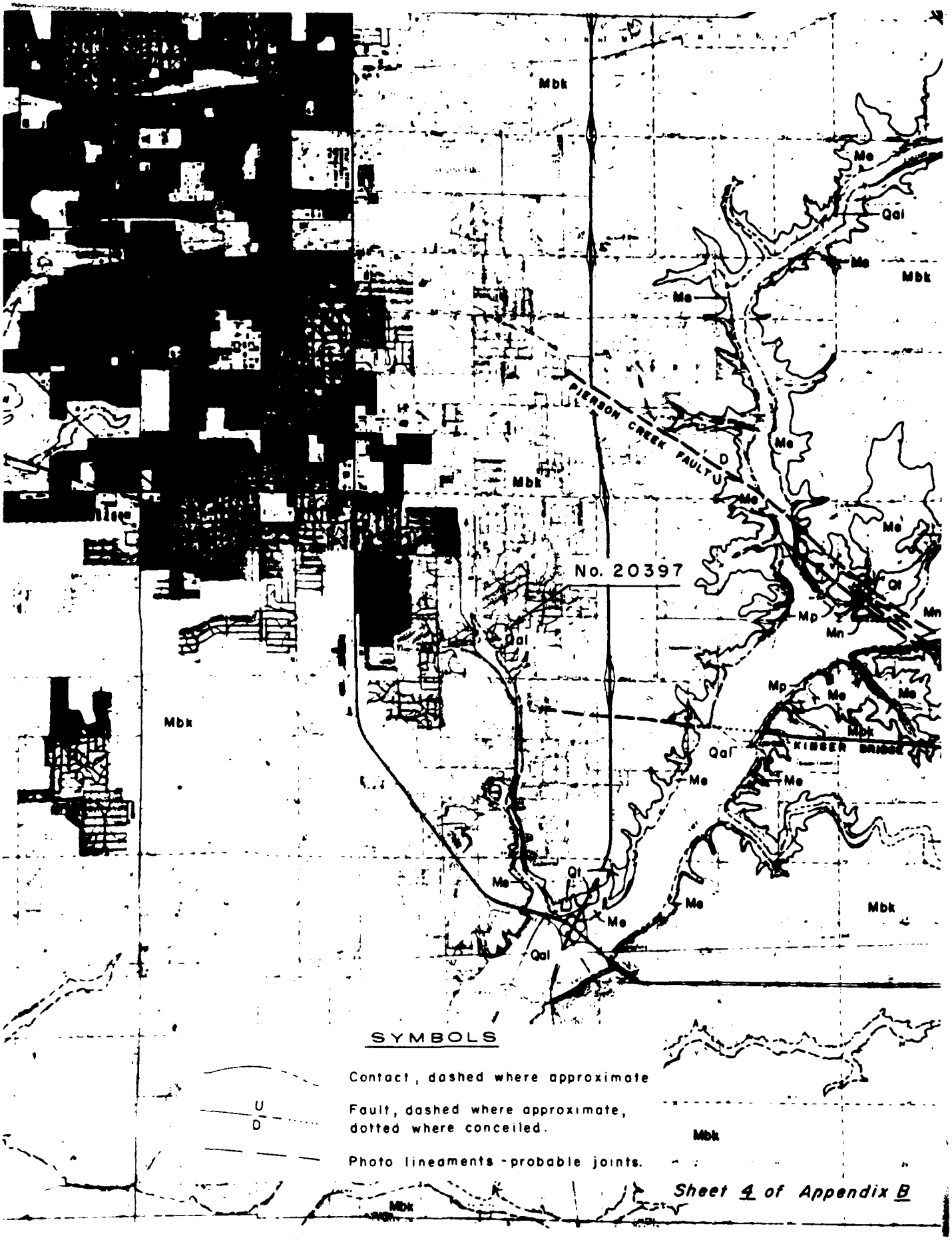
2.5 -

THICKNESS OF LOESSIAL DEPOSITS

SHEET 2 OF APPENDIX B

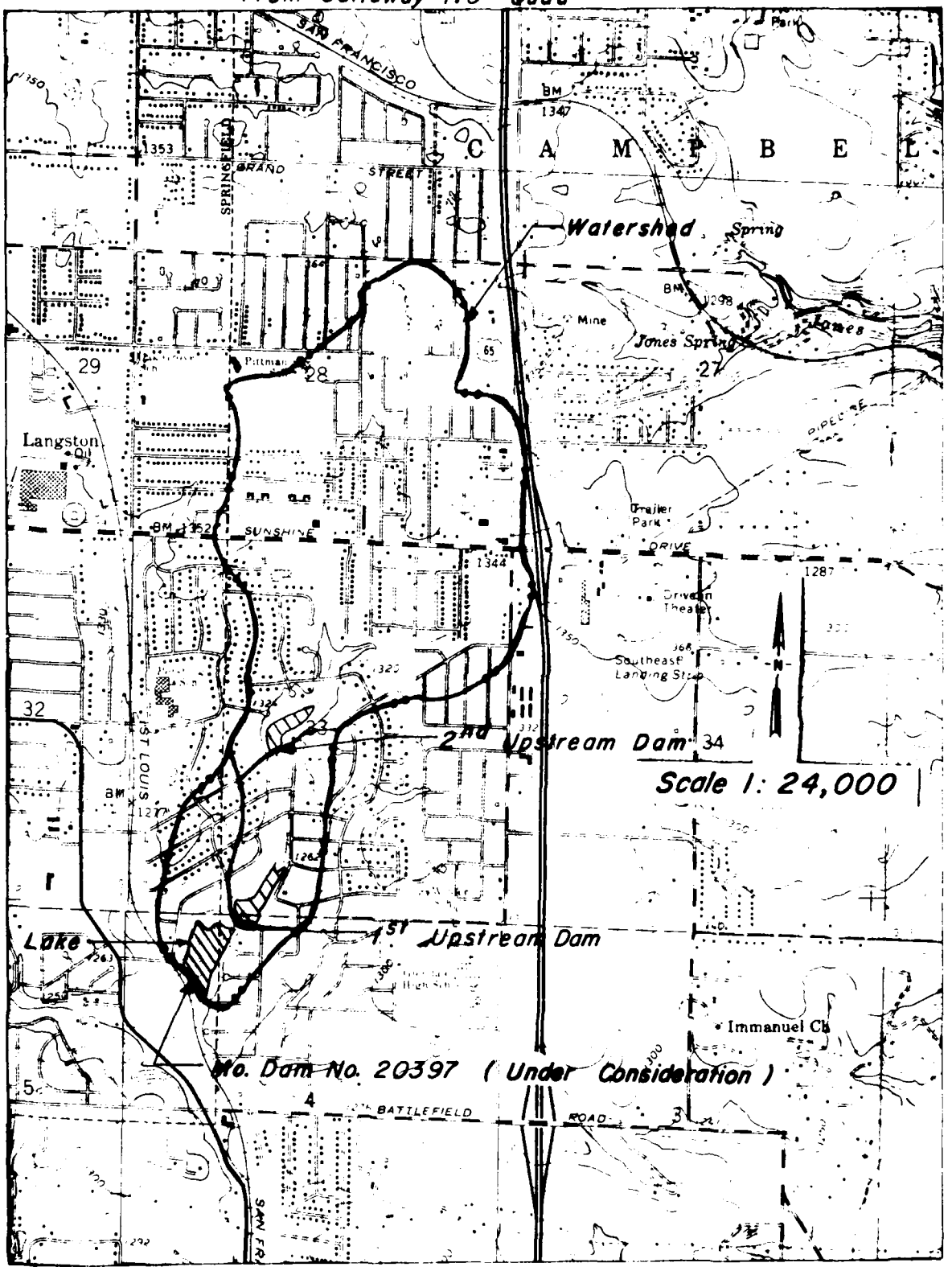


Sheet 3 of Appendix B


Mbk
Me
Qal
Mbk
Me
PIERSON CREEK FAULT
U
D
Me
Mbk
Me
Me
No. 20397
Qt
Mp
Mn
Mn
Qal
Mp
Me
Me
Mbk
KIMBER BRIDGE
Mbk
Qal
Me
Me
Qt
Me
Me
Mbk
Qal
Mbk
SYMBOLS
Contact, dashed where approximate
U
D
Fault, dashed where approximate, dotted where concealed.
Photo lineaments - probable joints.
Mbk

APPENDIX C

From Galloway 7.5' Quad



LAKE AND WATERSHED MAP

Sheet 1 Appendix C

HYDRAULICS AND HYDROLOGIC DATA

Design Data: From Field Measurements and Computations

Experience Data: No records are available. A resident of the area, who lives beside the dam, indicated that the dam has overtopped this year and that other overtoppings have occurred in the past years. The day of the inspection there was no indication of high water marks and no erosion of the embankment surfaces due to overtopping was found.

Visual Inspection: At the time of inspection, the pool level was 0.43 feet above normal pool.

Overtopping Potential: Flood routing studies were performed to determine the overtopping potential of the dam. The watershed and the reservoir surface areas were obtained by planimeter from the U.S.G.S. 7.5 minute, Galloway, Missouri quadrangle map. The storage volume was developed from this data. A 5 minute interval unit graph for the PMF was developed for this watershed, which resulted in a peak inflow of 320 c.f.s. and a time to peak of 11 minutes. Application of the probable maximum precipitation minus losses results in a flood hydrograph peak inflow of 12,430 c.f.s. Rainfall distribution for the 24 hour storm was according to EM 1110-2-1411.

Based on our analyses, the spillway will pass about 8 percent of the Probable Maximum Flood (PMF). The Probable Maximum Flood is defined as the flood discharge that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. The recommended guidelines from the Department of the Army, Office of the Chief of Engineers, require that the structure (small size with high downstream hazard potential) pass 50 to 100 percent of the PMF, without overtopping. Considering (1) the existence of two other dams upstream (will store part of the flood and will retard the peak), (2) that the height of the dam is only 15 feet and (3) that the maximum storage is 69 acre feet, 50 percent of the PMF has been determined to be the appropriate spillway design flood.

Two other dams exist upstream of this dam. To obtain a more realistic result of the flood routing studies, the PMF was considered acting simultaneously over the entire watershed area of the three dams. First, the PMF was routed

through the reservoir and spillway of the 2nd upstream dam (See LAKE WATERSHED MAP, Sheet 1 Appendix C) then the outflow hydrograph from this dam was combined with the inflow hydrograph of the 1st upstream dam watershed and routed through the reservoir and spillway of the 1st upstream dam; finally, the outflow hydrograph from this dam combined with the inflow hydrograph from the watershed of the dam under consideration was routed through the reservoir and spillway of the last dam. The same consideration was used for the routing of the 100 years and 10 years frequency floods. The flood routing studies were made using the HEC-1 Dam Safety Version Program.

The routing of the 50 percent of the PMF through the spillways and dams indicates that the dam under consideration will be overtopped by 1.93 feet at elevation 102.13. The duration of the overtopping will be 10.92 hours, and the maximum outflow will be 5878 c.f.s. The routing of the 100 years frequency flood indicates that the dam will be overtopped by 0.95 feet. The duration of the overtopping will be 5.00 hours, and the maximum outflow will be 2175 c.f.s.

The routing of the 10 years frequency flood indicates that the dam will be overtopped by 0.66 feet. The duration of the overtopping will be 2.67 hours, and the maximum outflow will be 1322 c.f.s.

The computer inputs, outputs and hydrographs for the 50 percent of the PMF, the 100 years flood and the 10 years flood are shown in this Appendix C.

OVERTOPPING ANALYSIS FOR LEE MCLEAN DAM

INPUT PARAMETERS FOR THE ROUTING OF THE PMF

1. Unit Hydrograph - SCS Dimensionless - Flood Hydrograph Package (HEC-1); Dam Safety Version Was Used.
   Hydraulic Inputs Are as Follows:

   a. Twenty-four Hour Rainfall of 26.9 Inches for 200 Square Miles - All Season Envelope

   b. Drainage Area = 73.5 Acres; = 0.12 Square Miles

   c. Travel Time of Runoff 0.23 Hrs.; Lag Time 0.14 Hrs.

   d. Soil Conservation Service Soil Group B

   e. Soil Conservation Service Runoff Curve No. 94 (AMC) III

   f. Proportion of Drainage Basin Impervious 0.25

Note: For the 100 years and 10 years flood, the Soil Conservation Service Runoff Curve No. 80 (AMC II) was used. A 24 hour rainfall of 8.0 in. was used for the 100 yrs. flood and 5.7 in. for the 10 yrs. flood. The Springfield, Missouri rainfall distribution for 1.00 square mile drainage (area supplied by the St. Louis U.S. Corps of Engineers District) was used for the 100 yrs. and 10 yrs. flood.

2. Spillways

   a. Primary Spillway: Box Culvert Type, 3-(4'-6"X2'-1") Sections, Crest El. 97.1

   b. Emergency Spillway (None)

      Length -- ft.; Side Slopes --; C = --

   c. Dam Overflow

      Length 700 ft.; Crest El. 100.2; C = 3.0

3. Spillway and Dam Rating:

Curve prepared by Hanson Engineers. Data provided to computer on Y4 and Y5 cards.

Method Used:
Weir Condition: $Q = CLH^{1.5}$

Box Culvert (Entrance Control): U.S. Bureau of Public Roads. Chart 288-D-2912

Note: Time of Concentration From Equation $Tc=(\frac{11.9\ L^3}{H})^{.385}$

California Culvert Practice, California Highways and Public Works, Sept. 1942.

SUMMARY OF DAM SAFETY ANALYSIS

1. Unit Hydrograph for the PMF

   a. Peak - 318 c.f.s.

   b. Time to Peak 10 Min.

2. Flood Routings Were Computed by the Modified Puls Method

   a. Peak Inflow

   50% PMF 6159 c.f.s.; 100% PMF 12,430 c.f.s.
   100 yrs. 2571 c.f.s. 10 yrs. 1322 c.f.s.

   b. Peak Elevation

   50% PMF 102.13; 100% PMF 103.32
   100 yrs. 101.15 10 yrs. 100.86

   c. Portion of PMF That Will Reach Top of Dam

   8 percent; Top of Dam Elev. 100.2 Ft.

3. Computer Input and Output Data for these studies are shown on the next sheets of this Appendix.

```
A       OVERTOPPING ANALYSIS FOR DAM #6
A       STATE ID NO 20397 CO NO 077 CO NAME GALLOWAY
A       HANSON ENGINEERS INC. DAM SAFETY INSPECTION JOB #79511
B    300                5
B1     5
J      1        6       1
J1  0.05      0.1    0.15    0.20    0.50     1.0
K      0        1                               3       1
K1      INFLOW HYDROGRAPH COMPUTATION FOR 2ND UPSTREAM DAM
M      1        2    0.76            0.76       1                       1
P      0     26.9     102     120     130
T                                                      -1     -94             0.15
U2  0.29     0.17
X      0     -.1        2
K      1        2                               4       1
K1     RESERVOIR ROUTING BY MODIFIED PULS AT 2ND UPSTREAM DAM
Y                                  1       1
Y1     1                                                17      -1
Y4 137.1   138.1   139.1   140.1   140.5   141.1   142.1   143.1   144.1   146.1
Y5     0      59     161     240     270     320     370     430     470     550
$A     0     3.7     8.3    22.4
$E 123.1   137.1   143.1   153.1
$$ 137.1
$D 140.5     3.0     1.5     400
K      0        3                               3       1
K1      INFLOW HYDROGRAPH COMPUTATION FOR 1ST UPSTREAM DAM
M      1        2    0.12            0.12       1                       1
P      0     26.9     102     120     130
T                                                      -1     -94             0.10
U2  0.20     0.12
X      0     -.1        2
K      2        3                               3       1
K1      COMBINE ROUTED AND LOCAL INFLOW AT 1ST UPSTREAM DAM
K      1        4                               4       1
K1      RESERVOIR ROUTING BY MODIFIED PULS AT 1ST UPSTREAM DAM
Y                                  !       !
Y1     1                                                18      -1
```

```
K      2      3                                    3      1
K1      COMBINE ROUTED AND LOCAL INFLOW AT 1ST UPSTREAM DAM
K      1      4                                    4      1
K1      RESERVOIR ROUTING BY MODIFIED PULS AT 1ST UPSTREAM DAM
Y                                  !      !
Y1     1                                                18     -1
Y4  110.1   111.1   112.1   113.2   114.1   115.1   116.1   117.1   118.1
Y5      0      30      80     120     160     185     215     235     270
$A      0     4.2     8.3    14.7
$E   97.1   110.1   113.1   118.1
$$  110.1
$D  113.2     3.0     1.5     825
K      0      5                                    3      1
K1      INFLOW HYDROGRAPH COMPUTATION FOR DAM NO 6
M      1      2    0.12            0.12      1                          1
P      0   26.9     102     120     130
T                                                -1     -94             0.25
W2   0.23   0.14
X      0     -.1       2
K      2      5                                    3      1
K1      COMBINE ROUTED AND LOCAL INFLOW AT DAM NO. 6
K      1      6                                0      4      1
K1      RESERVOIR ROUTING BY MODIFIED PULS AT DAM NO 6
Y                                  1      1
Y1     1                                                37     -1
Y4   97.1    98.1    99.1   100.2   101.1   102.1   103.1   104.1   106.1
Y5      0      40     108     162     216     250     290     317     371
$A      0     9.2    14.7
$E   85.1    97.1   103.1
$$   97.1
$D  100.2     3.0     1.5     700
K     99
```

P.M.F. INPUT DATA

SHEET 6 APPENDIX C

********** ********** ********** ********** ****. ***

1

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

				RATIOS APPLIED TO FLOWS					
OPERATION	STATION	AREA	PLAN	RATIO 1 0.05	RATIO 2 0.10	RATIO 3 0.15	RATIO 4 0.20	RATIO 5 0.50	RATIO 6 1.00
HYDROGRAPH AT	1	0.76	1	474.	948.	1422.	1896.	4740.	9480.
	(	1.97)	(	13.42)(	26.84)(	40.27)(	53.69)(	134.22)(	268.44)(
ROUTED TO	2	0.76	1	231.	848.	1401.	1886.	4788.	9602.
	(	1.97)	(	6.55)(	24.01)(	39.66)(	53.39)(	135.59)(	271.89)(
HYDROGRAPH AT	3	0.12	1	88.	176.	264.	352.	880.	1761.
	(	0.31)	(	2.49)(	4.99)(	7.48)(	9.97)(	24.93)(	49.86)(
2 COMBINED	3	0.88	1	268.	948.	1612.	2168.	5494.	11014.
	(	2.28)	(	7.59)(	26.83)(	45.66)(	61.39)(	155.58)(	311.87)(
ROUTED TO	4	0.88	1	213.	942.	1529.	2084.	5418.	10947.
	(	2.28)	(	6.02)(	26.66)(	43.30)(	59.02)(	153.42)(	309.98)(
HYDROGRAPH AT	5	0.12	1	84.	167.	251.	334.	835.	1670.
	(	0.31)	(	2.36)(	4.73)(	7.09)(	9.46)(	23.65)(	47.30)(
2 COMBINED	5	1.00	1	228.	1050.	1751.	2381.	6159.	12430.
	(	2.59)	(	6.45)(	29.73)(	49.60)(	67.41)(	174.41)(	351.97)(
ROUTED TO	6	1.00	1	129.	927.	1690.	2298.	5878.	11889.
	(	2.59)	(	3.66)(	26.24)(	47.84)(	65.06)(	166.46)(	336.65)(

1

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	136.88	137.10	140.50
STORAGE	16.	17.	34.
OUTFLOW	0.	0.	270.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
0.05	139.99	0.00	31.	231.	0.00	16.00	0.00
0.10	141.08	0.58	37.	848.	0.75	15.83	0.00
0.15	141.42	0.92	40.	1401.	2.08	15.75	0.00
0.20	141.68	1.18	41.	1886.	4.33	15.75	0.00
0.50	142.87	2.37	50.	4788.	6.67	15.75	0.00
1.00	144.37	3.87	64.	9602.	12.75	15.75	0.00

1 SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	109.96	110.10	113.20
STORAGE	18.	18.	37.
OUTFLOW	0.	0.	120.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
0.05	113.31	0.11	38.	213.	1.58	16.42	0.00
0.10	113.67	0.47	42.	942.	4.33	15.83	0.00
0.15	113.88	0.68	43.	1529.	5.92	15.75	0.00
0.20	114.05	0.85	45.	2084.	6.83	15.75	0.00
0.50	114.85	1.65	53.	5418.	12.83	15.75	0.00
1.00	115.86	2.66	64.	10947.	17.92	15.75	0.00

1 SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	97.12	97.10	100.20
STORAGE	37.	37.	69.
OUTFLOW	1.	0.	162.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
0.05	99.53	0.00	62.	129.	0.00	18.08	0.00
0.10	100.70	0.50	75.	927.	3.17	15.92	0.00
0.15	100.99	0.79	79.	1690.	4.75	15.83	0.00
0.20	101.19	0.99	82.	2298.	5.92	15.83	0.00
0.50	102.13	1.93	94.	5878.	10.92	15.83	0.00
1.00	103.32	3.12	111.	11889.	16.92	15.75	0.00

```
A        OVERTOPPING ANALYSIS FOR LEE MCLEAN AND JOHN Q. HAMMONS LAKE # 3 (DAM # 6)
A        STATE ID NO 20397 CO NO 077 CO NAME GALLOWAY
A        HANSON ENGINEERS INC. DAM SAFETY INSPECTION JOB #79511
B     72                 20
B1     5
J      1        1         1
J1   1.0
K      0        1                                  3        1
K1       INFLOW HYDROGRAPH COMPUTATION FOR 2ND UPSTREAM DAM
M      0        2      0.76                0.76        1                                  1
O     72      8.0
O1  .028     .028     .028     .028     .028     .028     .028     .028     .028     .028
O1  .028     .028     .028     .028     .028     .028     .028     .028     .060     .060
O1  .060     .060     .060     .060     .060     .060     .060     .112     .112     .112
O1  .112     .122     .135     .324     .448    1.250    1.639     .449     .324     .135
O1  .122     .112     .112     .112     .112     .060     .060     .060     .060     .060
O1  .060     .060     .060     .060     .028     .028     .028     .028     .028     .028
O1  .028     .028     .028     .028     .028     .028     .028     .028     .028     .028
O1  .028     .028
T                                                          -1      -80                0.15
W2  0.29     0.17
X      0       -.1        2
K      1        2                                  4        1
K1       RESERVOIR ROUTING BY MODIFIED PULS AT 2ND UPSTREAM DAM
Y                                      1        1
Y1     1                                                  17       -1
Y4  137.1    138.1    139.1    140.1    140.5    141.1    142.1    143.1    144.1    146.1
Y5      0       59      161      240      270      320      370      430      470      550
$A      0      3.7      8.3     22.4
$E  123.1    137.1    143.1    153.1
$$  137.1
$D  140.5      3.0      1.5      400
K      0        3                                  3        1
K1       INFLOW HYDROGRAPH COMPUTATION FOR 1ST UPSTREAM DAM
M      0        2      0.12                0.12        1                                  1
O     72      8.0
O1  .028     .028     .028     .028     .028     .028     .028     .028     .028     .028
O1  .028     .028     .028     .028     .028     .028     .028     .028     .060     .060
O1  .060     .060     .060     .060     .060     .060     .060     .112     .112     .112
O1  .112     .122     .135     .324     .448    1.250    1.639     .449     .324     .135
O1  .122     .112     .112     .112     .112     .060     .060     .060     .060     .060
O1  .060     .060     .060     .060     .028     .028     .028     .028     .028     .028
O1  .028     .028     .028     .028     .028     .028     .028     .028     .028     .028
O1  .028     .028
T                                                          -1      -80                0.10
W2  0.20     0.12
```

```
O1  .028    .028    .028    .028    .028    .028    .028    .028    .028    .028
O1  .028    .028
T                                                   -1      -80             0.10
W2  0.20    0.12
X      0     -.1       2
K      2       3                                    3       1
K1      COMBINE ROUTED AND LOCAL INFLOW AT 1ST UPSTREAM DAM
K      1       4                                    4       1
K1      RESERVOIR ROUTING BY MODIFIED PULS AT 1ST UPSTREAM DAM
Y                                       1       1
Y1     1                                                18      -1
Y4 110.1    111.1   112.1   113.2   114.1   115.1   116.1   117.1   118.1
Y5     0      30      80     120     160     185     215     235     270
$A     0     4.2     8.3    14.7
$E  97.1    110.1   113.1   118.1
$$ 110.1
$D 113.2     3.0     1.5     825
K      0       5                                    3       1
K1      INFLOW HYDROGRAPH COMPUTATION FOR DAM NO 6
M      0       2    0.12              0.12        1                       1
O     72     8.0
O1  .028    .028    .028    .028    .028    .028    .028    .028    .028    .028
O1  .028    .028    .028    .028    .028    .028    .028    .028    .060    .060
O1  .060    .060    .060    .060    .060    .060    .060    .112    .112    .112
O1  .112    .122    .135    .324    .448   1.250   1.639    .449    .324    .135
O1  .122    .112    .112    .112    .112    .060    .060    .060    .060    .060
O1  .060    .060    .060    .060    .028    .028    .028    .028    .028    .028
O1  .028    .028    .028    .028    .028    .028    .028    .028    .028    .028
O1  .028    .028
T                                                   -1      -80             0.25
W2  0.23    0.14
X      0     -.1       2
K      2       5                                    3       1
K1      COMBINE ROUTED AND LOCAL INFLOW AT DAM NO. 6
K      1       6                                    2       4       1
K1      RESERVOIR ROUTING BY MODIFIED PULS AT DAM NO 6
Y                                       1       1
Y1     1                                                37      -1
Y4  97.1     98.1    99.1   100.2   101.1   102.1   103.1   104.1   106.1
Y5     0      40     108     162     216     250     290     317     371
$A     0     9.2    14.7
$E  85.1     97.1   103.1
$$  97.1
$D 100.2     3.0     1.5     700
K     99
```

1 ********** ********** ********** ********** **********

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 1.00
HYDROGRAPH AT	1	0.76	1	1906.
	(	1.97)	(	53.97)(
ROUTED TO	2	0.76	1	1954.
	(	1.97)	(	55.33)(
HYDROGRAPH AT	3	0.12	1	299.
	(	0.31)	(	8.48)(
2 COMBINED	3	0.88	1	2253.
	(	2.28)	(	63.81)(
ROUTED TO	4	0.88	1	2263.
	(	2.28)	(	64.07)(
HYDROGRAPH AT	5	0.12	1	308.
	(	0.31)	(	8.72)(
2 COMBINED	5	1.00	1	2571.
	(	2.59)	(	72.79)(
ROUTED TO	6	1.00	1	2175.
	(	2.59)	(	61.59)(

1 SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	136.88	137.10	140.50
STORAGE	16.	17.	34.
OUTFLOW	0.	0.	270.

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	136.88	137.10	140.50
STORAGE	16.	17.	34.
OUTFLOW	0.	0.	270.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	141.71	1.21	42.	1954.	1.67	12.33	0.00

1 SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	109.96	110.10	113.20
STORAGE	18.	18.	37.
OUTFLOW	0.	0.	120.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	114.10	0.90	45.	2263.	6.00	12.33	0.00

1 SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	97.12	97.10	100.20
STORAGE	37.	37.	69.
OUTFLOW	1.	0.	162.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	101.15	0.95	81.	2175.	5.00	12.67	0.00

```
A       OVERTOPPING ANALYSIS FOR LEE MCLEAN AND JOHN Q. HAMMONS LAKE # 3 (DAM 6)
A       STATE ID NO 20397 CO NO 077 CO NAME GALLOWAY
A       HANSON ENGINEERS INC. DAM SAFETY INSPECTION JOB #79511
B     72              20
B1     5
J      1       1       1
J1   1.0
K      0       1                               3       1
K1      INFLOW HYDROGRAPH COMPUTATION FOR 2ND UPSTREAM DAM
M      0       2    0.76            0.76       1                       1
O     72    5.70
O1  .020    .020    .020    .020    .020    .020    .020    .020    .020    .020
O1  .020    .020    .020    .020    .020    .020    .020    .020    .048    .048
O1  .048    .048    .048    .048    .048    .048    .048    .072    .072    .0772
O1  .072    .094    .116    .248    .305    .828   1.125    .306    .248    .116
O1  .094    .072    .072    .072    .072    .048    .048    .048    .048    .048
O1  .048    .048    .048    .048    .020    .020    .020    .020    .020    .020
O1  .020    .020    .020    .020    .020    .020    .020    .020    .020    .020
O1  .020    .020
T                                                       -1     -80            0.15
W2  .29     0.17
X      0     -.1       2
K      1       2                               4       1
K1      RESERVOIR ROUTING BY MODIFIED PULS AT 2ND UPSTREAM DAM
Y                               1       1
Y1     1                                                17      -1
Y4 137.1   138.1   139.1   140.1   140.5   141.1   142.1   143.1   144.1   146.1
Y5     0      59     161     240     270     320     370     430     470     550
$A     0     3.7     8.3    22.4
$E 123.1   137.1   143.1   153.1
$$ 137.1
$D 140.5     3.0     1.5     400
K      0       3                               3       1
K1      INFLOW HYDROGRAPH COMPUTATION FOR 1ST UPSTREAM DAM
M      0       2    0.12            0.12       1                       1
O     72    5.70
O1  .020    .020    .020    .020    .020    .020    .020    .020    .020    .020
O1  .020    .020    .020    .020    .020    .020    .020    .020    .048    .048
O1  .048    .048    .048    .048    .048    .048    .048    .072    .072    .0772
O1  .072    .094    .116    .248    .305    .828   1.125    .306    .248    .116
O1  .094    .072    .072    .072    .072    .048    .048    .048    .048    .048
O1  .048    .048    .048    .048    .020    .020    .020    .020    .020    .020
O1  .020    .020    .020    .020    .020    .020    .020    .020    .020    .020
O1  .020    .020
T                                                       -1     -80            0.10
W2  0.20    0.12
```

```
O1  .072    .094    .116    .248    .305    .828   1.125    .306    .248    .116
O1  .094    .072    .072    .072    .072    .048    .048    .048    .048    .048
O1  .048    .048    .048    .048    .020    .020    .020    .020    .020    .020
O1  .020    .020    .020    .020    .020    .020    .020    .020    .020    .020
O1  .020    .020
T                                                    -1     -80            0.10
W2 0.20    0.12
X      0      -.1       2
K      2       3                                     3       1
K1       COMBINE ROUTED AND LOCAL INFLOW AT 1ST UPSTREAM DAM
K      1       4                                     4       1
K1       RESERVOIR ROUTING BY MODIFIED PULS AT 1ST UPSTREAM DAM
Y                                    1       1
Y1     1                                                18      -1
Y4 110.1   111.1   112.1   113.2   114.1   115.1   116.1   117.1   118.1
Y5     0      30      80     120     160     185     215     235     270
$A     0     4.2     8.3    14.7
$E  97.1   110.1   113.1   118.1
$$ 110.1
$D 113.2     3.0     1.5     825
K      0       5                                     3       1
K1       INFLOW HYDROGRAPH COMPUTATION FOR DAM NO 6
M      0       2    0.12              0.12       1                      1
O     72    5.70
O1  .020    .020    .020    .020    .020    .020    .020    .020    .020    .020
O1  .020    .020    .020    .020    .020    .020    .020    .020    .048    .048
O1  .048    .048    .048    .048    .048    .048    .048    .072    .072    .0772
O1  .072    .094    .116    .248    .305    .828   1.125    .306    .248    .116
O1  .094    .072    .072    .072    .072    .048    .048    .048    .048    .048
O1  .048    .048    .048    .048    .020    .020    .020    .020    .020    .020
O1  .020    .020    .020    .020    .020    .020    .020    .020    .020    .020
O1  .020    .020
T                                                    -1     -80            0.25
W2 0.23    0.14
X      0      -.1       2
K      2       5                                     3       1
K1       COMBINE ROUTED AND LOCAL INFLOW AT DAM NO. 6
K      1       6                                     2       4       1
K1       RESERVOIR ROUTING BY MODIFIED PULS AT DAM NO 6
Y                                    1       1
Y1     1                                                37      -1
Y4  97.1    98.1    99.1   100.2   101.1   102.1   103.1   104.1   106.1
Y5     0      40     108     162     216     250     290     317     371
$A     0     9.2    14.7
$E  85.1    97.1   103.1
$$  97.1
$D 100.2     3.0     1.5     700
K     99
```

10 YR. FLOOD INPUT DATA

SHEET 10 APPENDIX C

********** ********** ********** ********** **********

1

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 1.00
HYDROGRAPH AT	1	0.76	1	1189.
	(	1.97)	(	33.68)(
ROUTED TO	2	0.76	1	1194.
	(	1.97)	(	33.81)(
HYDROGRAPH AT	3	0.12	1	186.
	(	0.31)	(	5.26)(
2 COMBINED	3	0.88	1	1380.
	(	2.28)	(	39.06)(
ROUTED TO	4	0.88	1	1200.
	(	2.28)	(	33.99)(
HYDROGRAPH AT	5	0.12	1	195.
	(	0.31)	(	5.51)(
2 COMBINED	5	1.00	1	1298.
	(	2.59)	(	36.77)(
ROUTED TO	6	1.00	1	1322.
	(	2.59)	(	37.44)(

1

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	136.88	137.10	140.50
STORAGE	16.	17.	34.

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	136.88	137.10	140.50
STORAGE	16.	17.	34.
OUTFLOW	0.	0.	270.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	141.30	0.80	39.	1194.	1.33	12.33	0.00

1 SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	109.96	110.10	113.20
STORAGE	18.	18.	37.
OUTFLOW	0.	0.	120.

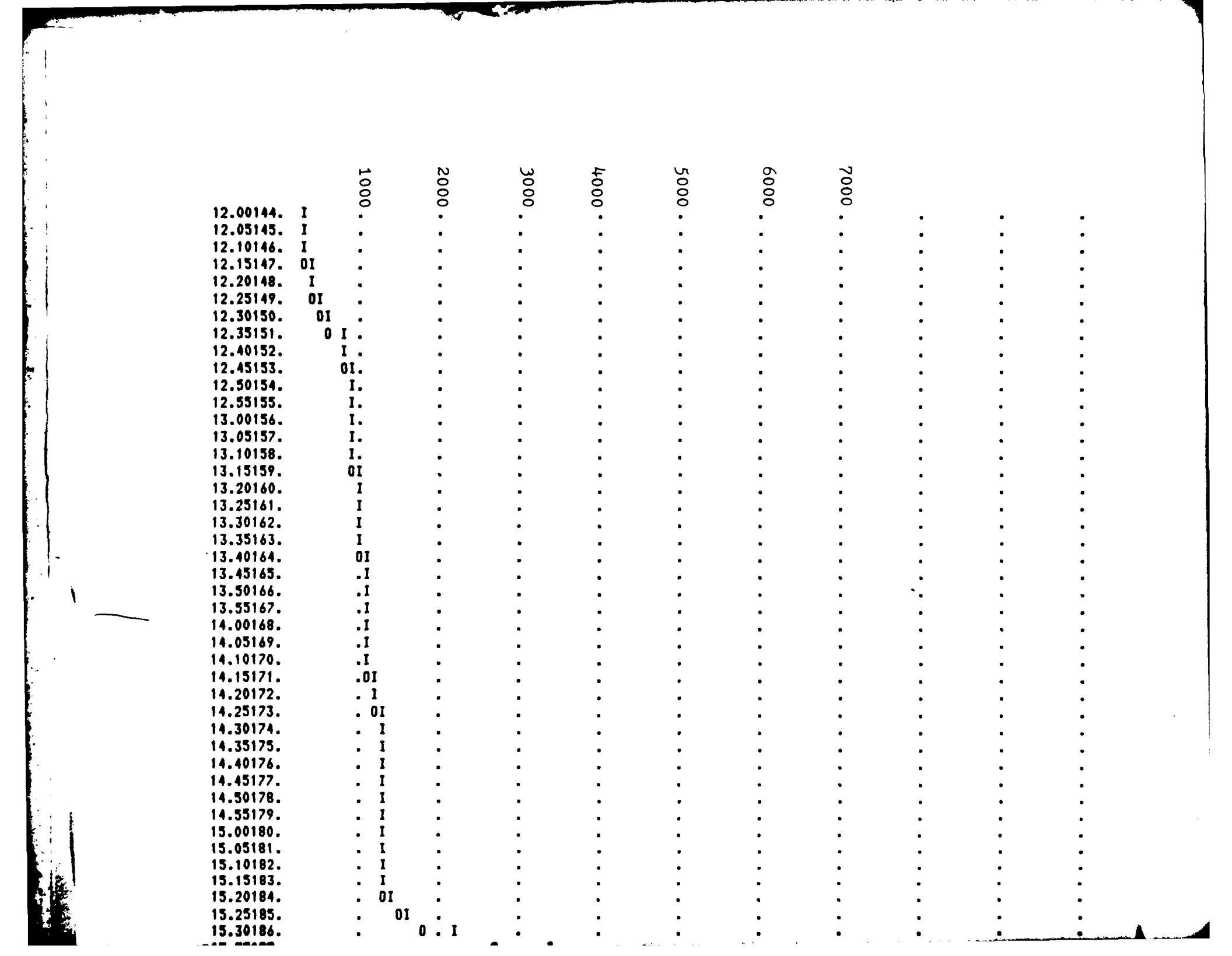
RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	113.77	0.57	42.	1200.	3.33	12.67	0.00

1 SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	97.12	97.10	100.20
STORAGE	37.	37.	69.
OUTFLOW	1.	0.	162.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	100.86	0.66	77.	1322.	2.67	12.67	0.00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2000
3000
4000
5000
6000
7000
12.00144.
12.05145.
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12.15147.
12.20148.
12.25149.
12.30150.
12.35151.
12.40152.
12.45153.
12.50154.
12.55155.
13.00156.
13.05157.
13.10158.
13.15159.
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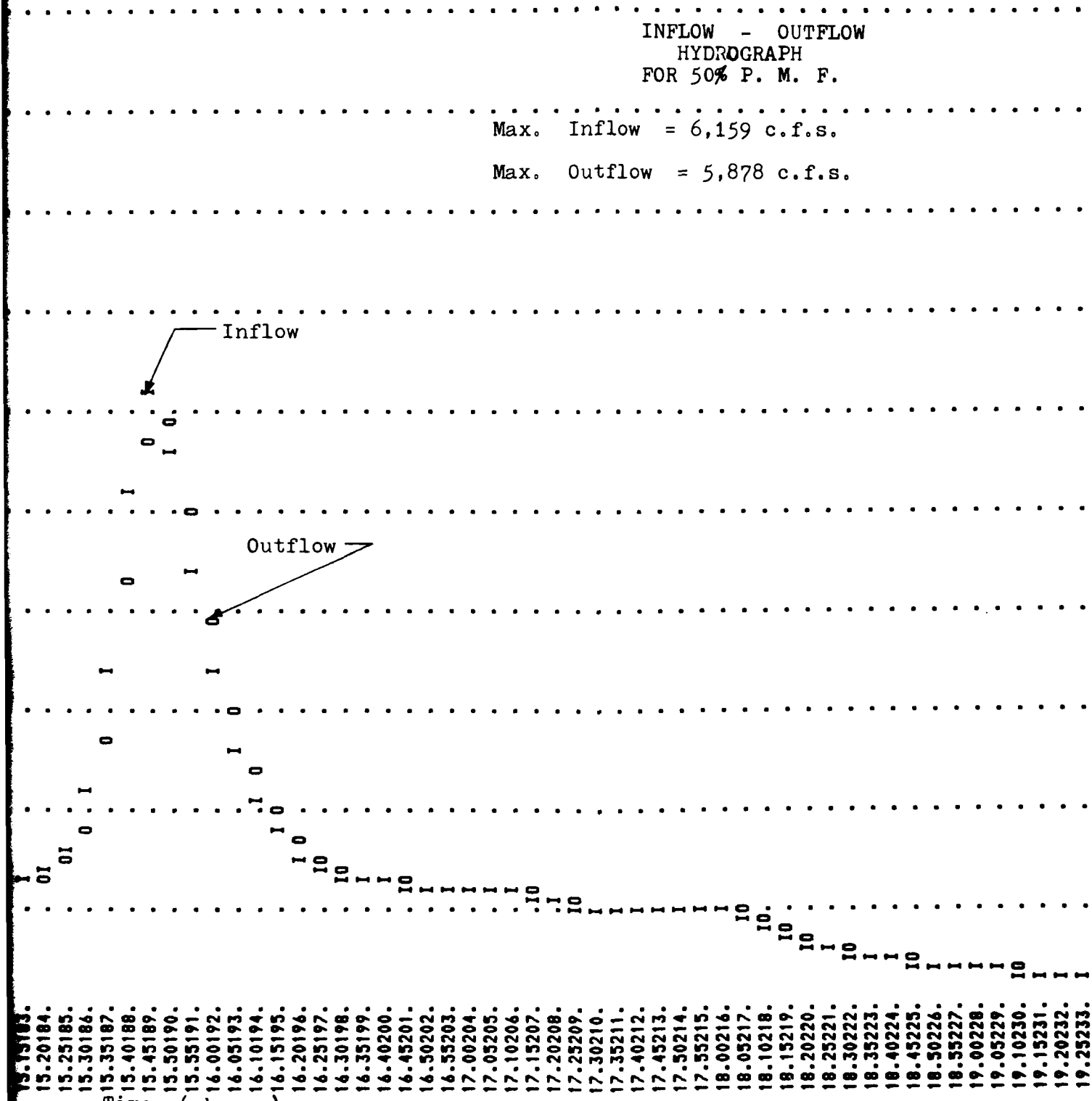
14.05169.
14.10170.
14.15171.
14.20172.
14.25173.
14.30174.
14.35175.
14.40176.
14.45177.
14.50178.
14.55179.
15.00180.
15.05181.
15.10182.
15.15183.
15.20184.
15.25185.
15.30186.

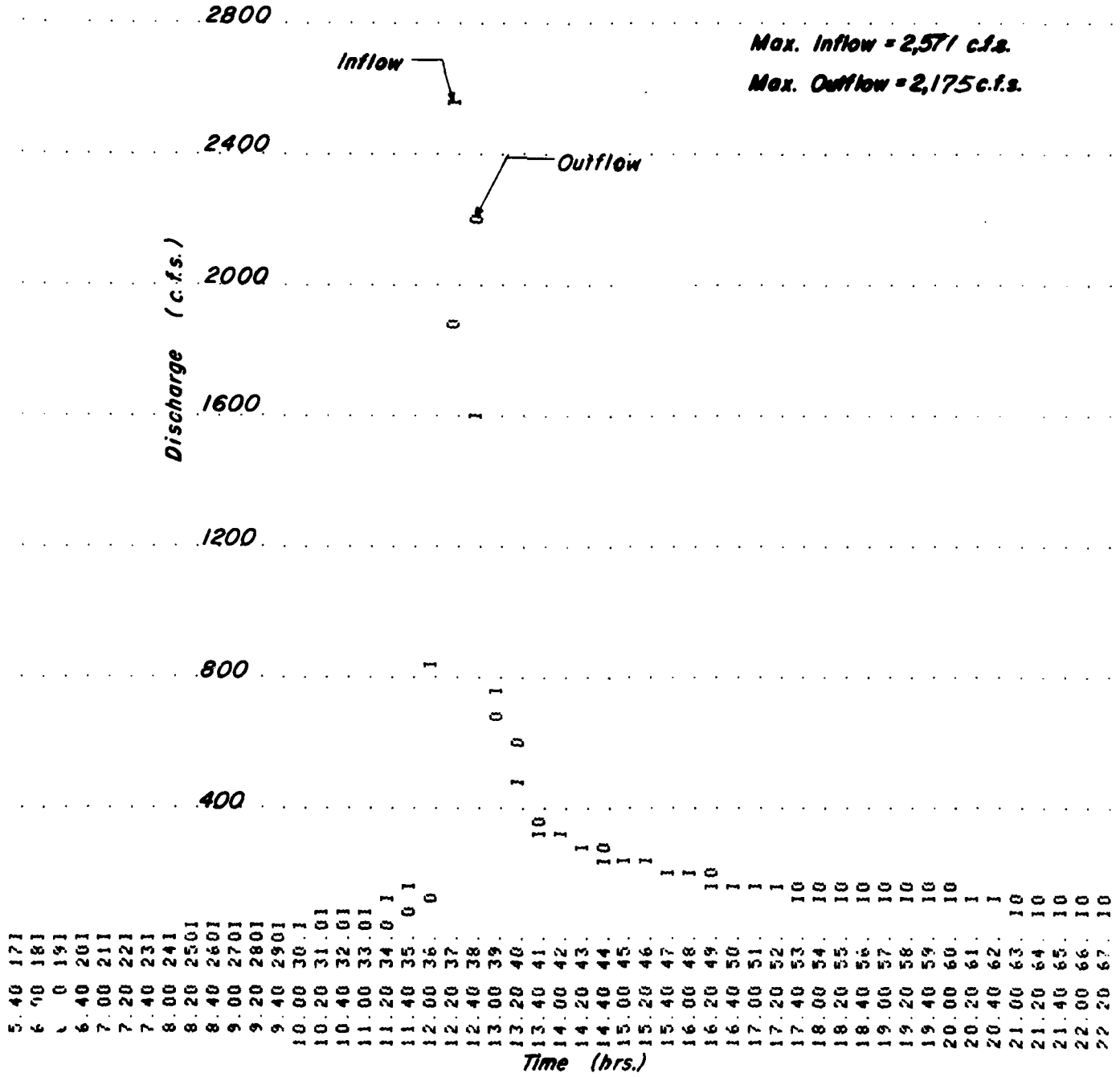
INFLOW - OUTFLOW
HYDROGRAPH
FOR 50% P. M. F.

Max. Inflow = 6,159 c.f.s.

Max. Outflow = 5,878 c.f.s.

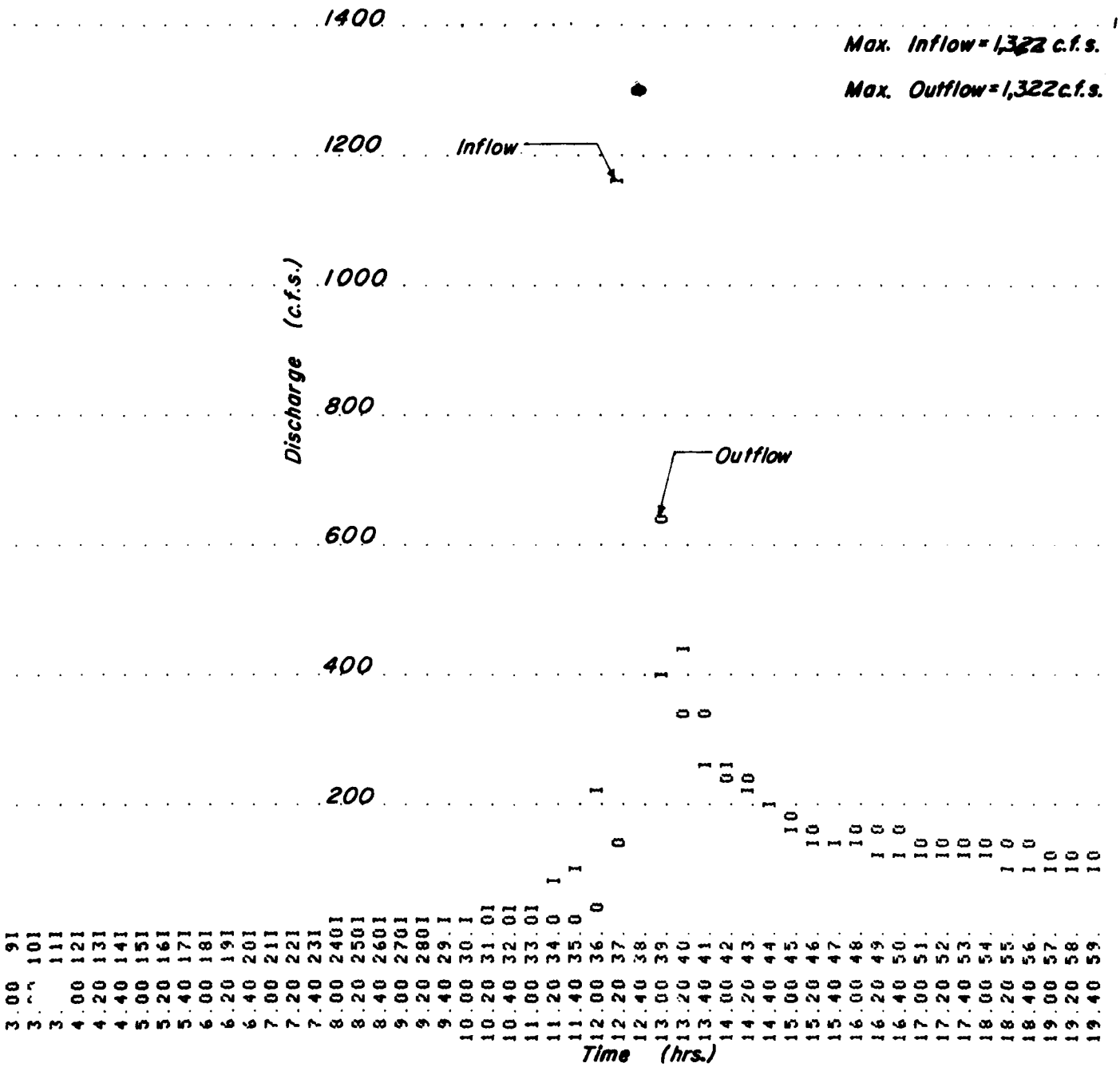


INFLOW - OUTFLOW HYDROGRAPH FOR 100 YRS. FLOOD



Sheet 13 Appendix C

INFLOW - OUTFLOW HYDROGRAPH FOR 10 YRS. FLOOD



APPENDIX D

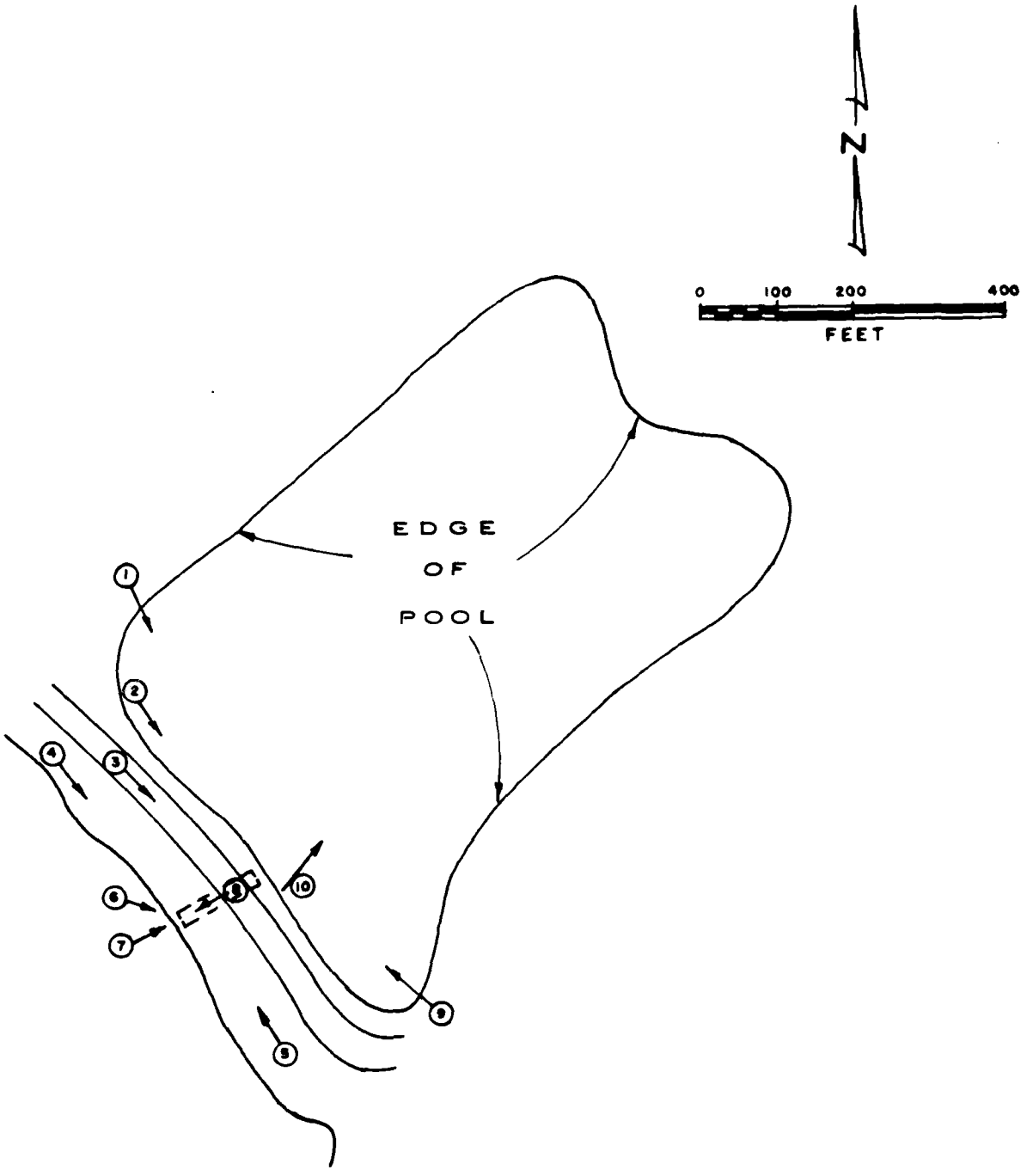


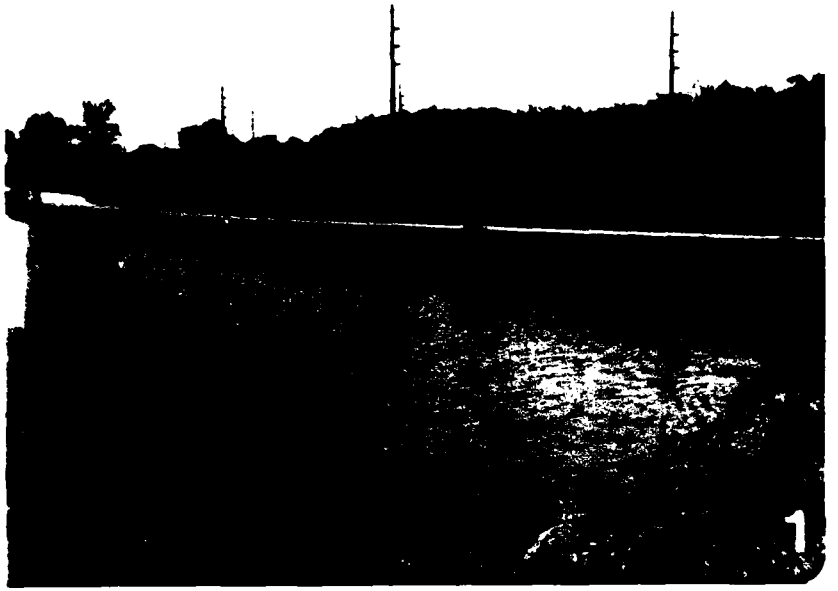
PHOTO INDEX

LEE McLEAN AND JOHN Q. HAMMONS LAKE #3

GREENE COUNTY, MO.

LIST OF PHOTOGRAPHS

Photo No.	
1.	Upstream Face
2.	Upstream Face (Note Erosion)
3.	Crest of Embankment
4.	Downstream Face, West Side
5.	Downstream Face, East Side
6.	Upstream Face Looking Northwest
7.	Primary Spillway and Chute
8.	Spillway Channel (Note Railroad Embankment and Box Culverts)
9.	Erosion Under Chute at Plunge Pool
10.	Lake and Reservoir Area
11.	Aerial Looking Southeast
12.	Aerial Looking North
13.	Aerial Looking West
14.	Aerial Looking Southwest Showing First Up-Stream Reservoir
15.	Upstream Face of First Dam Upstream
16.	Downstream Face of First Dam Upstream
17.	Spillway and Chute of First Dam Upstream
18.	Downstream Face of Second Dam Upstream
19.	Spillway and Chute of Second Dam Upstream
20.	Aerial of Second Dam Upstream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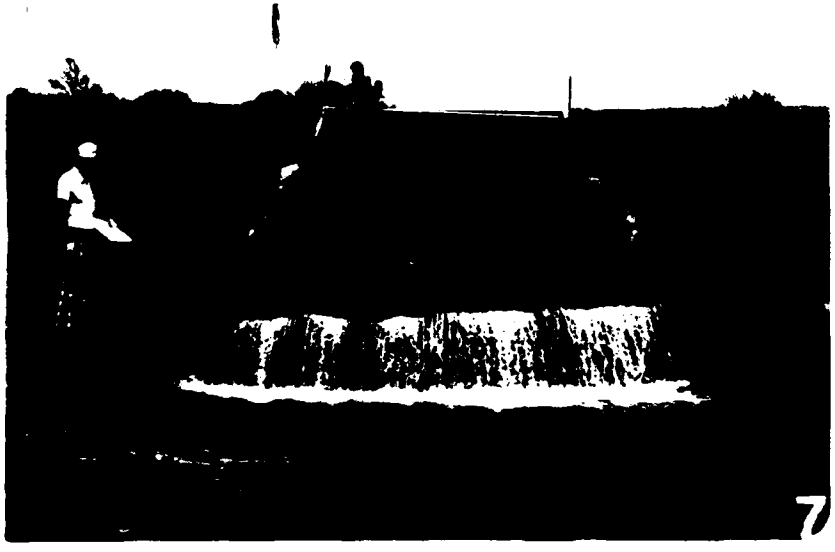
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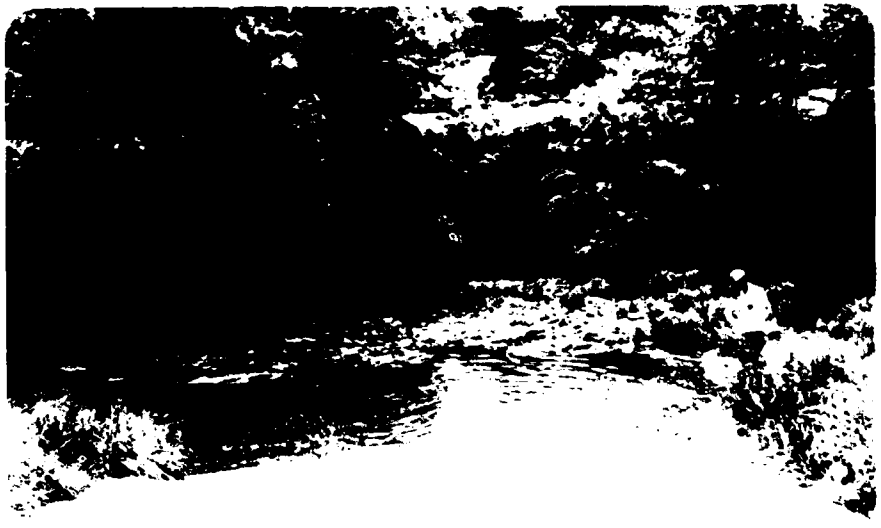


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10

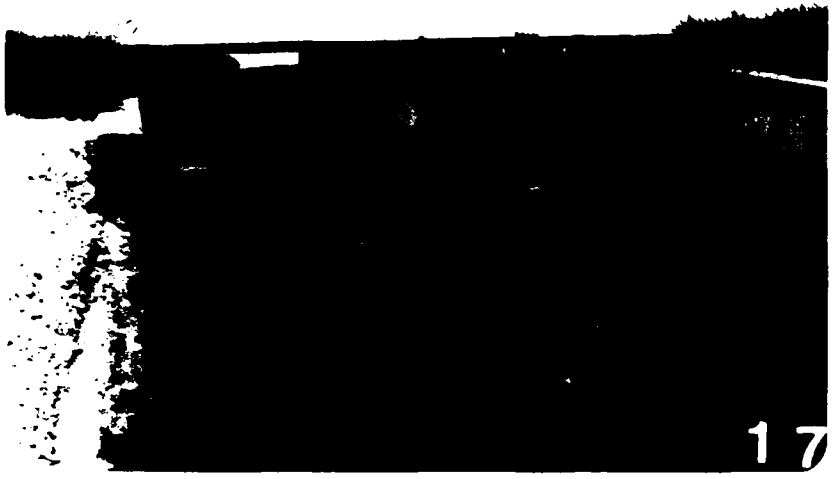

11


12


13


14


16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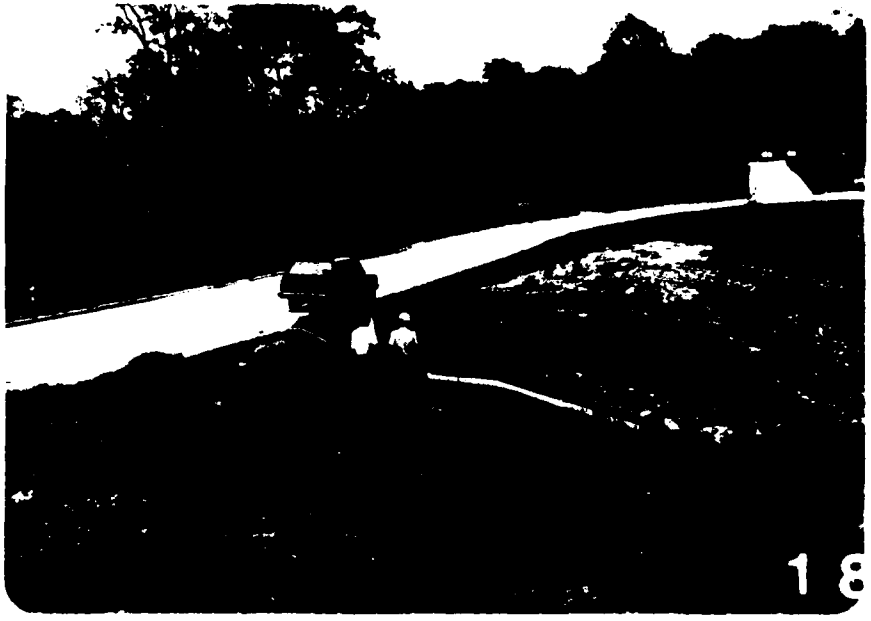
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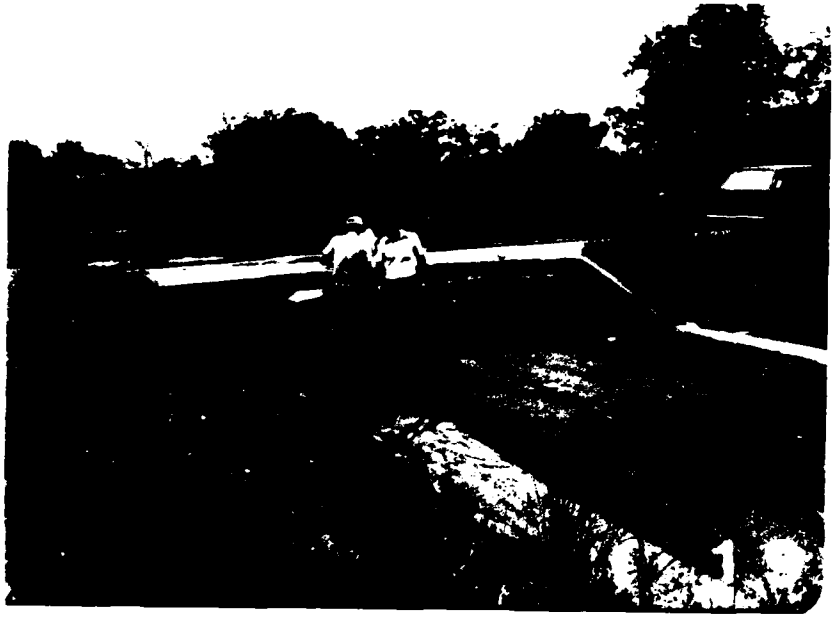


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FILME